

SEAMANS SE- CRETS.

Deuided into 2. partes, wherein is taught the
three kindes of Sayling, Horizontall, Paradoxall, and sayling vpon a
great Circle: also an Horizontall Tyde Table for the easie finding of
the ebbing and flowing of the Tydes, with a Regiment newly calcula-
ted for the finding of the Declination of the Sunne and many
other most necessary rules and instruments,
not heretofore set forth
by any.

Newly corrected by the author *John Davis* of *Sandbridge*,
neere *Northmouth*, in the Countie of *Devon*, Gent.



Imprinted at London by *Thomas Dawson*,
dwelling neere the three Cranes in the Vinetree,
and are there to be sold. 1607



To the right honourable Lord Charles Haward,
Baron of Effingham, Knight of the noble order of the
Garter, Lieutenant of her Maiesties Counties of Suffex and Surrey.
Constable of her Maiesties Honor and Castle of Win-
sor, Lord high Admirall of England, Ireland, and Wales, and of the
Dominions and Isles of the same, of the towne of Callis and marches
thereof, Normandy, Gascony, and Greynes, Captaine generall of
her Maiesties Seas and Nauie royal, and one of her
Maiesties most honorable priue Counsell, Iohn
Dauis wisheth increase of honour
and perfect felicitie.



Right Honourable and my especial good Lord, as
by the instinct of nature all men are desirous of
knowlege, and take pleasure in the varieties of
vnderstanding, so it is likewise ingrafted by the
same benefite of nature, in the hearts of true no-
bilitie, not onely to excell the vulgare sort but
also to cherrish, support, and countenance all
such as shall in due course prosecute their voca-
tion: and as such practises either speculatiue or
mechanicall shall receiue fauourable place in the
honourable opinion of nobilitie, by so much the more shall the practiser bee
esteemed: which is the cause that at this time imboldeneth me to present vn-
to your most honourable fauour this small treatise of Nauigation, being a
breefe collection of such practises as in my seuerall voyages I haue from expe-
rience collected. Among which in three seuerall attempts for the discouerie
of the Northwest passage, thereby to finde a short and Nauigable course vnto
the rich and famous Countries of Cathayo, China, Pegu, the Isles of Molucan
and Phillipina, that thereby to the great and inestimable benefite of our coun-
try, there might be a rich and plentiful trade procured betweene vs and the
sayd nations in short time to be perfourmed, and with great safetie in regarde
of the course: which action and discouery (by meanes of that honourable
Counseller Sir Fraunces Walsingham knight, principall Secretary to her Ma-
iestie) was with good resolution accepted by the Merchants of London, but
in the decay of his honourable life, the attempt was likewise quailed: but

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howsoever mens mindes alter, yet vndoubtedly, there is passage navigable, and easie to be performed by that course (whensoever it shall please God to reueale the same) by intvincible reasons, and sufficient experience to be proved; and although before I entred into that discovery, I was sufficiently persuaded of the certainty thereof, by historical relation substantially confirmed whereof to the aduenturers I made sufficient prooffe, but especially to my worshipfull good friend Maister *William Sanderson*, the onely Merchant that to his great charges with most constant trauaile did labour for the finishing thereof: yet I thanke God that of late it hath bin my very good chance to receiue better assurance then euer before of the certaintie of that passage, and such was my vehement desire for the performance thereof, that thereby I was onely induced to goe with M. *Candish* in his second attempt for the South Seas, vpon his constant promise vnto me, that when wee came to the *California*, I should there haue his Pinnice with my owne Barck (which for that purpose went with me to my great charges) to search that Northwest discovery vpon those backe partes of *America*, but God hath otherwise disposed our purposes in his deuine Iudgements, for M. *Candish* being halfe way through the straights of *Magellane*, and impatient of the tempestuous furrowes of that place, hauing all his Shippes and company with him, returned for *Brasil*, by the authoritie of his commaund, when with a leading wind we might haue passed the same, and returning more then 80. leagues towarde *Brasil*, my selfe being in his Ship named the *Desire*, without Boate, Oares, Sayles, Cables, cordage, victuals or heath, & my company sufficient for that attempt was seperated in a freit of weather, and forced to seeke the next shore for my releefe, & recovering a harborow by vs named Port Desire, being in the latitude of 48. deg. did there repaire my most miserable wantes, and there staying 4. moneths in most lamentable distresse, did againe conclude with my company to giue another attempt to passe the straights, as my best meane to gaine releefe. And threetimes I was in the South Seas, but still by furious weather forced backe againe: yet notwithstanding all this my labor to performe the voyage to his profite, and to saue my selfe (for I did aduenture and my good friends for my sake 1100. pounds in the action) M. *Candish* was content to account me to be the authour of his ouerthrow, and to write with his dying hand that I ranne from him, when that his owne Shippe was returned many moneths before me:

I am bolde to make this relation vnto your Lordship, onely to satisfie your Honor of my conuersation, for were I faultie of so foule a crime, I were worthy of ten thousand torments, in presuming to present this Treatise to your honourable Lordship and now referring my cause to your Lordships consideration, I will againe returne to my purpose.

In those Northwest voyages where Navigation must be executed in most

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exquisite sorte, in those attempts I was enforced to search al possible meanes required in sayling, by which occasion I haue gathered together this breefe treatise, which with my selfe I do dedicate to your honourable protection, being desirous if it lay in my power, to doe farre geater matters in your Lordships seruice, hoping of your honourable pardon, because it is only done to shew my dutifull affection, and not for any singularitie that the worke containeth. For I thinke there be many hundreds in England that can in a farre greater measure and more excellent methode expresse the noble art of Navigation, and I am fully perswaded that our Countrie is not inferiour to any for men of rare knowledge, singular explication, and exquisite execution of the Artes Mathematicke, for what Strangers may be copared with M. Thomas Digges Esquire, our Countryman the great master of Archmastrie, and for Theoricall speculations & most cunning calculation, M Dee and M. Thomas Heriotts are hardly to be matched: and for the mecanicall practises drawn from the Artes of Mathematicke, our Country doth yeelde men of principal excellencie, as M. Emery Mullenex for the exquisite making of Globes bodies, and M. Nicholas He'lyar for the singularitie of pertrature haue the prayse of Europe, M. Baker for his skill and surpassing grounded knowledge for the building of Ships aduantageable to all purpose, hath not in any nation his equall.

And now that I may returne to the painefull Seaman, it is not unknowne to all nations of the earth, that the English goeth before al others in the practises of sayling, as appeareth by the excellent discovery of Sir *Frances Drake* in his passage through the straights of Magilane, which being then so rawly knowne, he could not haue passed, vnlesse he had bene a man of great practise and rare resolution: so much I may boldly say, because I haue seene and tasted the frowardnes of the place, with the great vnlikelyhooe of any passage to be that way.

I might here repeat the most valiant and excellent attempts of Sir *Hugh Willoughbie*, Sir *Iohn Hawkins*, Sir *Humphry Gilbert*, and your Lordships seruant M. *George Raymond*, with diuers others that haue giuen most resolute attempts in the practises of Navigation, as well for the discovery as other execution, whereby good prooffe is made, that not onely in the skill of Navigation, but also in the mecanicall execution of the practises of sayling, wee are not to be matched by any nation of the earth.

And sith Navigation is the meane whereby Countreyes are discovered, and communitie drawne betweene nation and nation, the worde of God published to the blessed recovery of the forraine ofcastes from whence it hath pleased his diuine Maiestie as yet to detayne the brightnes of his glories and that by Navigation common weales through mutuall trade are not only

sustained, but mightily enriched, with how great esteeme ought the painefull Seaman to be embraced by whose hard adventures such excellent benefites are atcheiued, for by his exceeding great hazzards the forme of the earth, the quantities of Countries, the diuersitie of nations and the natures of Zones, Climats, Countries and people, are apparantly made known vnto vs Besides, the great benefites mutually interchanged betweene nations, of such fruits, commodities, and artificiall practises wherewith God hath blessed each particular country, coast, and nation, according to the nature & scituation of the place.

For what hath made the Spaniard to be so great a Monarch, the Commander of both Indias, to abound in wealth and all natures benefites, but only the painefull industrie of his Subiects by Nauigation, their former trade was only figs orenges, and oyle, but now through Nauigation is brought to be golde, siluer pearles, silkes, and spice, by long and painefull trade recovered. Which great benefites onely by her Maiesties louing clemencie and merciful fauour he doth possesse: for it her highnes and her most honourable Lordes would not regard the small distance betweene her dominions and those famous rich kingdomes, the easines of the passage being once discovered, (the Northwest I meane) with the full sufficiencie of her highnes Subiects to effect the same, there could then be no doubt, but her stately seate of London should bee the storehouse of Europe, and a nurse to all nations, in yeelding al Indian commodities in a far better condition, and at a more easie rate then now brought vn to vs, exchanging commodities of our owne store, with a plentifull returne at the first hand, which now by many exchanges are brought vnto vs.

Then should the Spaniard againe returne to his old trade, and our sacred Soueraigne be seated the Commander of the earth: which trade and most fortunate discovery, we aboue all nations ought most principally to regard, be cause of the singularity & inuincible force of our Shipping, which is not onely the commanding fortresse of our Country, but also the dread of our aduersary, and glory of our nation: wherein we doe in no sort flatter our selues for it was made apparant to all nations of the earth, by the late most famous conquest that her Maiestie had against the huge supposed inuincible flecte of the Spaniard, being by her naue vnder the Comaund of your Lordship who there in person and in place of her Maiestie, to your eternal glorious fame did disgrace their glory and confound their force, & manifest their weakenes by their dastardly flight, through Gods prouidence and your Lordships stately resolution.

Then sith Nauigation is a matter of so great inoment, I suppose that euery mā is bound in duty to giue his best furtherance thereunto: among whom as the most vnmeete of all, yet wishing all good to the painefull traoueller, I haue published this short treatise, naming it the *Seamans Secrets*, because by cer-
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taine questions demaunded and aunswered, I have not omitted any thinge that appertaineth to the secret of Navigation, whereby if there may grow any increafe of knowledge or ease in practice, it is the thing which I cheifly desire.

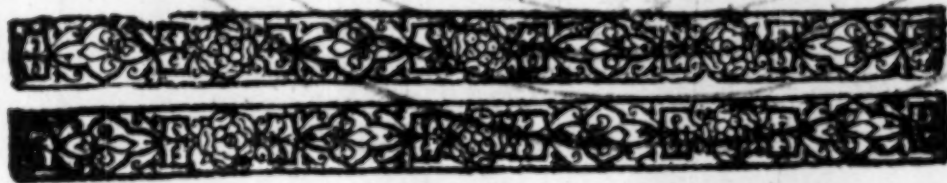
To manifest the necessary conclusions of Navigation in breefe and shorte tearmes is my only intent, & therefore I omit to declare the causes of tearmes and diffinition of artificiall wordes, as matter superfluous to my purpose, neither haue I laid downe the cunning conclusions apt for Schollers to practise vpon the shore but onely those things that are needefully required in a sufficient Seaman: beseeching your honourable Lordship to

pardon my bolnesse, and with your fauourable countenance to regard my dutifull affection, I most humbly commit your good Lordship to the mercies of God, who long preserue your health with continuall increafe of honour.

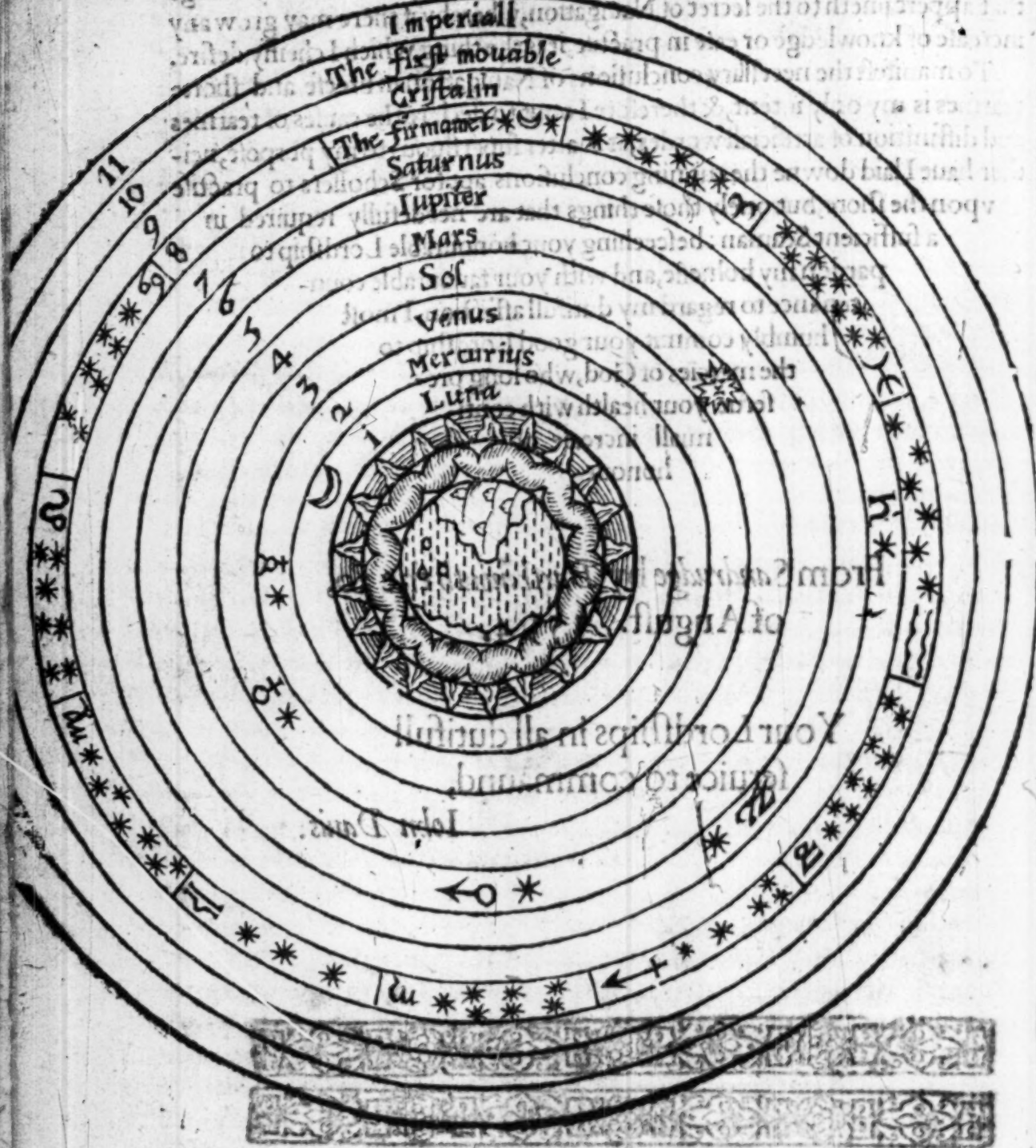
From Sandrudge by Dartmouth the 20,
of August. 1594.


Your Lordships in all dutifull
seruice to commaund,

John Davis:



...the doctrine is demonstrated and answered, I have not omitted any thing
...the first movable
...Cristalin
...The firmament





THE FIRST BOOKE OF THE SEAMANS SECRETS.

What is Nauigation?



Nauigation is that excellent Art which demonstrateth by infallible conclusion, how a sufficient Ship may bee conducted the shortest good way from place to place, by Course and Trauers.

What are these infallible conclusions?

Nauigation consisteth of three partes, which being well understood and practised, are conclusions infallible, whereby the skillfull Pilote is vnder of all doubt to effect the thing purposed. Of which, the first is the Horizontall Nauigation, which manifesteth all the varieties of the Ships motion within the Horizontall plaine superficies, where euery line drawne is supposed a parallell.

The second is a paradorall or Cosmographicall Nauigation, which demonstrateth the true motion of the Ship vpon any course assigned in longitude, latitude and distace, either particular or general, and is the skillfull gathering together of many Horizontall into one infallible and true motion paradorall.

The third is great Circle Nauigation, which teacheth how vpon a great Circle drawne betwene any two places assigned, (being the onely shortest way betwene place and place) the Ship may bee conducted, and is performed by the skillfull application of Horizontall and paradorall Nauigation.

What is a Course?

A Course is that paradorall line which passeth betwene place and place. According to the true Horizontall position of the Magnet, vpon which line the Ship prosecuting her motion, shall be conducted betwene the sayd places.

What is a Trauers?

A Trauers is the varietie or alteration of the Shippes motion vpon the shift of winde, within any Horizontall plaine superficies, by the good
collection

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collection of which Trauerſes, the ſhips vniſorme motion or Coſe is giuen.

What Instruments are neceſſary for the execution
of this excellent ſkill.

The Instrumentes neceſſarie for a ſkilfull Seaman, are a Sea Com-
paſſe, a Croſſe ſtaffe, a Quadrant, an Aſtrolabie, a Chart, an instrument
magneticall for the finding of the variation of the Compaſſe, an Horizontall
plaine Sphere, a Globe, and a paradoxall Compaſſe. By which instruments
all conſuſions and infallible demonſtrations, Hydrographicall, Geographi-
call, and Coſmographicall are without controlement of errour to be per-
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ficient for the ſeamans uſe: the Aſtrolabie and Quadrant being instruments
very vncertaine for Sea obſervations.

What is the Sea Compaſſe?

The Sea Compaſſe is a principall instrument in Nauigation, repreſen-
ting and diſtinguiſhing the Horizon, ſo that the Compaſſe
ueniently be named an Artificial Horizon, becauſe by it are mani-
fied the limits and diſtinctions of the Horizon required to the perfect vi-
ſion, which diſtinctions are the 32. points of the Compaſſe, wher-
by the Horizon is diuided into 32. equall partes, and euery of thoſe point
per name, as in the figure ſollowing appeareth. Alſo euery point of the
Compaſſe doth containe degrees, minutes, ſeconds, and thirds, &c. They
are called degrees of Azimuth whercof there are in euery point 11.
the whole Compaſſe or Horizon containeth, 360. degrees of Azimuth, wher-
by if you multiply 11. degrees, the degrees that ech point containeth, by 32. the
points of the Compaſſe, it yeeldeth 360. the degrees of the Compaſſe. And of
minutes each point containeth 3. being 1. of an hower, ſo that the whole
Compaſſe is hereby diuided into 12. howers, by which accompt there are in
an hower 15. degrees, ſo that euery degree containeth 4. minutes of time,
for an hower conſiſting of 60. minutes, hath for his fifteenth part 4. minutes
of time, and in euery minute there is 60. ſeconds, and euery ſecond con-
taineth 60. thirds, either in degrees applyed to time, or degrees applyed to mea-
ſure: ſo that the generall content of the Compaſſe is 32. points, 360. degrees
and 24. howers with their minutes, ſeconds, and thirds.

What is the uſe of the 32 points of the Compaſſe.

The uſe of the 32. pointes of the Compaſſe, is to direct the ſkilful Pilote
by Horizontall traueſes, how hee may conclude the coſe or paradoxall
motion of his ſhip, thereby with the greater expedition to recouer the place
deſired, becauſe they diuide the Horizon into ſuch limits as are moſt apt for
Nauigation, they doe alſo diſtinguiſh the windes by their proper names, for
the

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the winde receiveth his name by that parte of the Horizon from whence it bloweth.

What is the vse of 360. degrees of Azimuth?

By the degrees of Azimuth is knowne the quantitie of the rising and setting of the Sunne, Moone and Starres, whereby is knowne the length of the dayes and nightes in all climates, and at all times, they also shew a most precise Horizontall distinction of the motion of the Sunn, Moone and Starres, whereby the certainty of time is measured, and the variation of the Compasse, with the Poles height is ingeniously knowne at all times and in all places by the helpe of the Globe.

How is the hower of the day knowne by the Compasse.

It hath bene an ancient custome among Mariners to divide the Compasse into 24. equall partes or howers, by which they have vsed to distinguish time, supposing an East Sunne to be 6. of the clocke, a Southeast Sunne 9. of the clocke, and a South Sunne 12. of the clocke: &c. as in the figure following shall plainly appeare. But this account is very absurd, for with vs in England (the Sunne having his greatest North declination,) it is somewhat past 7. of the clock, at an East Sunn, and at a Southeast Sunne it is past 10. of the clocke: also when the Sunne is in the Equinoctiall, the Sunne is halfe the day East, and halfe the day West, to all those that bee vnder the same, so that the Sunne then 4. to those people vseth but 2. points of the Compasse, to performe the motion of 12. howers: therfore the distinctions of time may not wel be given by the Compasse, vnlesse the Sunne be vpon the Meridian, or that you be farre toward the North, in such places where the Sunnes Horizontal motion is very oblique, for there the hower may be given by the Compasse, without any great error, but else where it cannot. Therefore those that trauaile either vse the Globe, or an Equinoctiall diall, by whom time may most certainly measured, if there be good consideration of the variation of the needle by which the Equinoctiall diall is directed, for this is a generall thing to be regarded aswell in the Compasse, as in any dials or other instrument, or conclusion whatsoeuer wherein the vse of the needle is required, that vnlesse there be good regard vnto the variation of the same, there can no good conclusion follow of any such practises.

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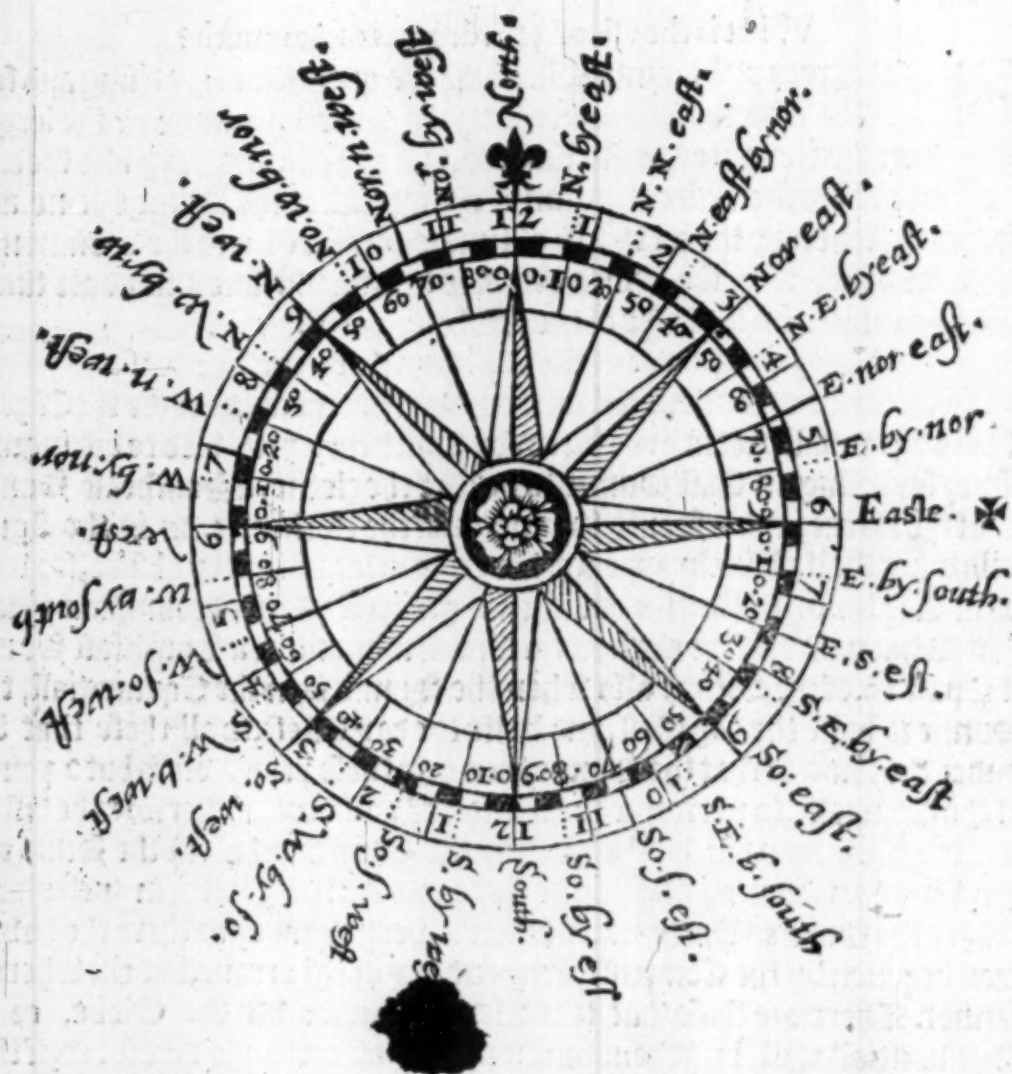
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The Seamans Secrets,



What is the next necessarie thing to be learned.

Having perfectly learned the Compasse, the next necessarie thing for a Seaman to know, is the alteration or shifting of tydes, that thereby he may with the greater safetie bring his Ship into any barred Port, Haven, Creeke, or other place, where tydes are to be regarded. And this difference of tydes in the alteration of flowing & reflowing, is by long experience found to be governed by the moone motion for in such proportion of time as the Moone doth separate her selfe from the Sunne, by the swiftnes of her naturall motion: in the like proportion of time doth one tide differ from another, therefore to vnderstand this difference of the Moones motion is the onely meane whereby the time of tydes is most precisely knowne.

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Of the Moones motion.

You must understand the Moone hath two kinde of motions, a naturall motion, and a violent motion, her violent motion is from the East towards the West, caused by the violent swiftness of the diurnal motion of primum mobile, in which motion the Moone is carried about the earth in 24. houers and 50. minutes neereff one day with another, for although the diurnal period of the first mouer be performed in 24. houers, yet because the Moone every day in her slowest naturall motion moueth 12. degrees, therefore she is not carried about the earth, untill that her motion be also carried about, which is in 24. houers and 50 minutes neereff.

Her naturall motion is from the West towards the East, contrary to the motion of the first moouer, wherin the Moone hath 3. differences of mooving a swift motion, a meane motion, and a slow motion, all which is performed by the diuine ordinance of the Creator, in 27. dayes and 8. houers neereff, through all the degrees of the Zodiac.

Her slowe motion is in the point of Auge or apogeo, being then farthest distant from the earth, and then she moueth in euery day 12. degrees.

Her swift motion is in the opposite of age or perigeo, being then neereff vnto the earth, at which time she moueth 14. degrees, with some small difference of minutes in euery 24. houers.

Between those two points is her meane motion, & then she moueth 13. degrees neereff: all which differences are caused by the excentricity of her Orbe wherein she moueth, and are onely performed in the Zodiac, but the Seamen for their better ease in the knowlege of tides, haue applyed this the Moones motion, to the points, degrees, and minutes of the Compasse, whereby they haue framed it to be an Horizontal motion which lieth by long practise is found to bee a rule of such certainties, that the error thereof bringeth no danger to the expert Seaman, therefore it is not amisse to followe their practised precepts therein.

In euery 29. daies 12 houers 44. minutes, one with another through the peere, the Sunne and Moone are in conjunction, and therefore that is the quantitie of time betwene change and change, for although the Moone in 27. daies and 8. houers performing her naturall motion, doth returne to the same minute of the Zodiac from whence she departed, yet being so returned shee doth not finde the Sunne in that parte of the Ecliptick where shee left him, for the Sunne in his naturall motion mouing euery day one degree towards the East, is moued so far from the place where the Moone left him, as that the Moone cannot ouertake the Sunne to come in conjunction with him, until she haue performed the motion of 2. daies 4. houers, and 44. minutes neereff, more then her naturall revolution, and that is the cause where-

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foze there are 29. daies, 12. howers, 44. minutes betweene change & change one with another through the whole yere: but the Seaman accompteth the ~~Moones~~ motion, to be vniſorm in all places of the ~~Zodiac~~ ^{the} limiting her generall ſeperation from the Sunne, to be ſuch as is her ſloweſt natural motion, which is 12. degrees, 02 48. minutes of time, in euery 24. howers.

By which accompt there are 30. dayes reckoned betweene change and change, being 11. howers, 16. minutes, more then in truth there is: but be-
cause this difference breedeth but ſmal error in their accompt of tides, ther-
foze to alter practiſed rules where there is no vrgent cauſe, were a matter
frivolous, which conſidered, I thinke it not amiſſe that we proceed therein
by the ſame methode that commonly is exerciſed.

Allowing the Moone in euery 24. howers to depart from the Sunne 12
degrees, 02 48. minutes of time, and in this ſeperation the Moone mooueth
from the Sunne Eaſtwards, untill ſhe be at the full, ſo: betweene the change
and the full, it is called the Moones ſeperation from the Sunne: ſo: after
the full ſhe doth apply to wards the Sunne, ſo that betweene the full and the
change it is called the Moones application to the Sunne, in which time of
application ſhe is to the Weſtward of the Sunne, as in her ſeperation ſhe
is to the Eaſtward, 02 I may ſay in the Seamans phraſe, all the time of
her application ſhe is before the Sunne, and in the time of her ſeperation ſhe
is abaft the Sunne.

Then if the Moone doe mooue 48. minutes of time in 24. howers, it fol-
loweth that ſhe doth moue 24. minutes in 12. howers, and in 6. howers ſhe
mooueth 12. minutes, therefore euery hower ſhe mooueth 2. minutes, and ſuch
as is the difference of her motion, ſuch is the alteration of tides, and therefore
euery tide differeth from the other 12. minutes, becauſe there is 6. howers
betweene tide and tide: and in euery hower the courſe of flowing 02 reflow-
ing altereth 2. minutes, where by it appeareth that in 24. howers the ſoure
tides of flowing and reflowing doe differ 48. minutes of time.

And ſith the whole knowledge of this difference 02 alteration of tides, as
alſo the quantitie of the Moones ſeperation and application to and from the
Sunne, dependeth vpon the knowledg of the Moones age, it is therefore ne-
ceſſarie that next you learne how the Sunne may be knowne.

For the perſormance whereof there are 2. numbers eſpecially required,
named the Prime and the Epact, ſo: by the prime the epact is found, and by
helpe of the Epact the Moones age is knowne.

Of the prime or Golden number.

The Prime is the ſpace of 19. yeres, in which time the moone perſormeth
all the varieties of her motion with the Sunne, & at the end of 19. yeres
beginneth the ſame reuolution againe, therefore the Prime neuer exceedeth
the number of 19. and this prime doth alwayes begin in January, and thus
the

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the prime is found: vnto the yeere of the Lord wherein you desire to know the prime adde 1. then diuide that number by 19. and the remaining number which commeth not into the quotient is the prime. Example in the yeere of our Lord 1590. I desire to know the prime, therefore I adde 1. vnto that yeere, and then it is 1591. which I diuide by 19. and it yeeldeth in the quotient 83. and there remaineth 14. vpon the diuision, which commeth not into the quotient, which 14. is the prime in the yeere of our Lord 1590.

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The Epact is a number proceeding from the ouerplus of the solar and lunar yeere: which number neuer exceedeth 30. because the Moones age neuer exceedeth 30. for the finding whereof this number onely serueth: and thus the Epact is knowne, which Epact doth alwaies begin in March, multiplie the prime by 11 (being the neereff difference between the solar and lunar yeere) diuide the product by 30. and the remainer is the Epact. Example in the yeere of our Lord 1590. I would know the Epact, first I seeke the prime of that yeere, and finde it to be 14. I therefore multiply 14. by 11. and that yeeldeth 154. which being diuided by 30. it giueth in the quotient 5. and there remaineth 4. vpon the diuision, which 4. is the Epact in the yeere 1590. which beginning in March, doth continue vntill the next March of the yeere 1591.

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Of the solar and lunar yeere.

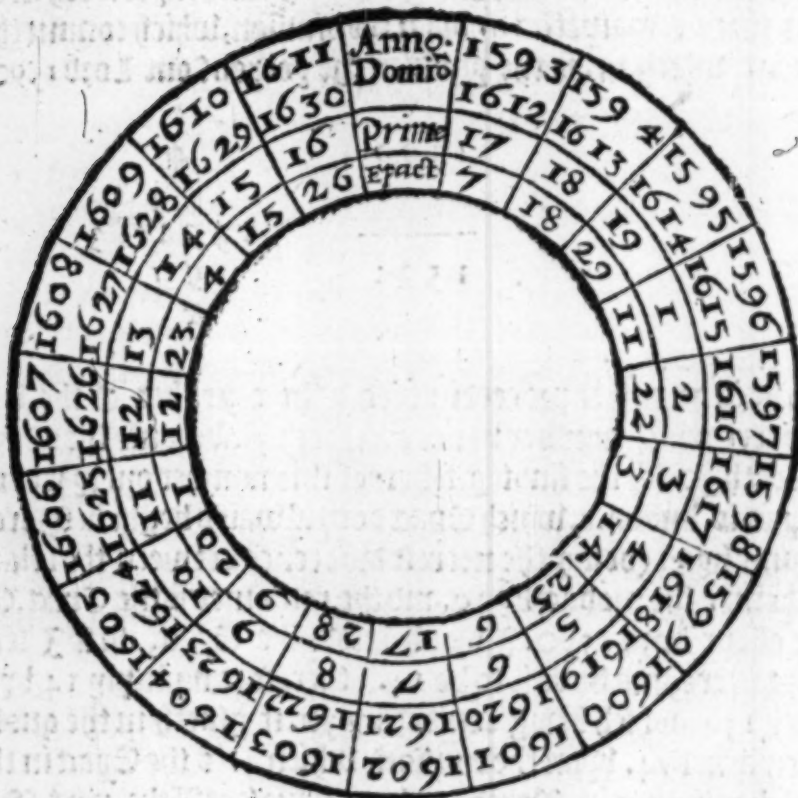
The solar yeere or the Suns yeere consisteth of 12. moneths, being 365. daies, and about 6. howers, the lunar yeere or the Moones yeere consisteth 12. Moones, and euery Moone hath 28. daies, 12. howers, 44. minutes neereff, which amount vnto 354. daies, 5. howers, 28. minutes, the content of the lunar yeere, which being subtracted from 365. daies, 6. howers, there resteth 11. daies and 32. minutes, the difference betweene the sayd yeeres, from which difference the Epact cometh.

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By this Table the prime and Epact may for ever be found, for when the yeeres be expired, you may begin againe and continue if for ever at your pleasure.



The first circle containeth the yeeres of our Lord, the second the prime, & the third and inner circle sheweth the Epact: under every yeere you shall finde his prime and Epact, the prime beginneth in Januarie, and the Epact in March.

How to find out the Moones age.

The number of moneths.

First consider the day of the moneth wherein you seeke the Moones age, then note how many moneths there are betwene the sayde moneth and March, including both moneths, unto those numbers adde the Epact of that yeere, that is, you must adde into one summe the day of the moneth, betwene March and your moneth, reckoning both moneths and the Epact, all which numbers layned together, if they exceede not 30. is the Moones age, if they be more then 30. cast away 30. as often as you can, and the remainder is the Moones age, if it be iust 30. it is then new Moone. if 7. it is the first quarter day

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day, if 15. it is full Moone, if 22. it is then the last quarter day, and thus the Moones age is found for ever.

And now being able for all times either past, present or to come, to give the Moones age, I think it good by a few questions convenient for the Seaman's practise, to make you understand the necessary use thereof.

For the account of Tydes.

When you desire to know the time of full Sea in any place, at all such seasons as occasion shall require, you must first learne what Moone maketh a full Sea in the same place, that is, upon what point of the Compasse the Moone is, when it is full Sea at the said place, you must also know what hower is appropriated to that point of the compasse, as before is shewed: for upon the change day it will alwaies be full Sea in that place, at the same instant of time, by which considerations you must thus proceed for the search of tydes.

Multiplye the Moones age by 4. deuide the product by 5. and to the quotient adde the hower, which maketh full Sea in that place upon the change day, if it exceede 12. cast away 12. as oft as you may, and then the hower of full Sea remaineth, and for every 1. that resteth upon your diuision, allow 12. min. to be added to the howers, for 2. 24. minutes, for 3. 36. and for 4. 48. minutes, for more then 4. will neuer remaine, and thus you may know your tides to a minute, Example, the Moone being twelue daies olde, I desire to know the time of full Sea at London: first it is found by experience, that a Southwest and Northeast Moone makes full sea at London, next, I consider that 3. of the clocke is the houre appropriated to that point of the Compasse, which number I keepe in memory, then I multiplye the Moones age, being 12. by 4. and that yeeldeth 48. which being deuided by 5. it giueth in the quotient 9. and thus remayneth, I adde the quotient 9. to the hower 3. and it maketh 12. howers, and for the remaining number 3. I also adde 36. minutes, so that I find when the Moone is 12. daies old, it is 12. of the clocke, and 36. minutes past, at the instant of full sea at London: by this order you may at all places & times know the certainty of your tides at your pleasure.

But those that are not practised in Arithmetick may account these tides in this sort, knowing how many daies old the Moone is, he must place the Moone upon that point of the Compasse which maketh full Sea at the place desired, and then reckoning from that point with the same according to the diurnal motion, must account so many points, and so many times 3. minutes as the Moone is daies old, that is for every day one point and 3. minutes, and there finding the Sun, he must consider what is the hower allowed to that point where he findeth the Sunne, for that is the hower of full Sea. As for Example, the Moone being 12. daies old, I desire to know the hower of full

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Sea at London, now finding by former experience, that a South-west
Moone maketh full Sea at London, I therefore place the Moone upon the
point South-west, then I account from the point South-west 12. points, rec-
koning with the Sunne according to the diurnall motion, South-west and
by west for the first point, West South-west for the second, West by South
for the third, West for the fourth point, and so forth untill I come to North,
which is 12. points from South-west, & because the Moone moueth 3. mi-
nutes more then a point in every day, I therefore adde thre times twelue,
which make 36. minutes to the point North, at which place I finde the
Sunne to be, and knowing that twelue of the clocke is appropriated to the
point North. I may therefore boldly say that at twelue of the clocke 26. mi-
nutes past, it is full Sea at London, when the Moone is twelue dayes olde,
which 36. minutes are added, because the Moone hath moued 36. minutes
more then twelue points in those 12. daies, which is one point and 3. mi-
nutes for every day, as before.

*Heere followeth a very necessary Instrument for
the knowledge of the Tydes, named an
Horizontall tyde Table.*

Or



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Of this Instrument and his parts.

This necessary instrument for the young practising seamans use, named an Horizontall tyde Table whereby he may shift his Sun and Moone (as they terme it) and know the time of his tides with ease and very certainly, besides the answering of many pleasant & necessary questions vnto amongst Mariners. I haue contriued into this methode, only for the benefit of such young practisers in Navigation.

The first part of this instrument is a Sea Compasse, deuided into 32. points or equall partes, the innermost circle of which Compasse is deuided into 24. howers, and euery of those into 4. quarters, each quarter being 15. minutes, and against euery point of the Compasse those places are layd downe, in which places it is full Sea when the Moone cometh vpon the same point, so that whatsoeuer is required as touching time, or the points of the Compasse is there to be knowne.

The next moueable circle vpon this Compasse, is limited to the Sunne, vpon whose index the Sunne is layd downe, which circle is deuided into 30. equall parts or daies, signifying the 30. daies between change and change: according to the Seamans Account, so that whatsoeuer is demanded as touching the age of the Moone, is vpon that circle to be knowne.

The vppermost moueable circle is applied to the Moone, vpon whose index the Moone is laid downe, which is to be placed either to the points and partes of the Compasse, or to the time of her age, as the question requireth which considered, the vse of this instrument is largely manifested, by these questions with their answers, following.

How to know the hower of the night by the Moone, being vpon any point of the Compasse by this Instrument.

1. Q. The Moone 10. daies olde, I demand what it is a clocke, when she is East North-east.

A. In this question the Moones age and the point of the Compasse is giuen, therby to know the hower, I therfore place the index of the mouebvpon the point East North-east, there keeping the same not to be moued, then because the Moone is 10. daies olde. I moue the index of the Sunne vntill I bring the tenth day of the moones age into the index of the moone, and there I looke by the Index of the Sunne and find vpon the Compasse that it is twelue of the clocke at noone and 30. minutes past, when the moone is vpon the point East North-east, being 10. daies olde.

2. Q. The Moone being twelue daies olde, I demand at what hower she will be vpon the point S. S. E.?

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2. A. In this question the point of the compasse and Moones age is given, as in the first, therefore I place the index of the Moone vpon the point S. S. E. and there holding it without mouing. I turne the index of the Sunne, vntil the twelfth day of the Moones age come to the index of the Moone, and then the index of the Sunne sheweth me vpon the Diall on the bowe 8. therefore I say that at 8. of the clocke at night the Moone was then vpon the point South Southeast.

And thus you may at all times know the hower of the night by the Moone, vpon any point of the Compasse, so that the Moones age be also had.

How by this Instrument, you may know at all times vpon what point of the Compasse the Moone is.

Q. When the Moone is 10. daies olde, vpon what point of the Compasse shall she be, at 9. of the clocke in the morning?

1. A. In this question the houre of the day and the Moones age is given, thereby to finde vpon what point of the Compasse she is at the same time. I therefore place the Index of the Sunne vpon the Compasse, at the hower 9. of the clocke in the morning, being vpon the point South east; then I turne the index of the Moone, vntil I bring it to the tenth day of her age; and then I see vpon the Compasse that the Moone is Northward by East, and 5. minutes to the Eastward, at 9. of the clocke when she is 10. daies olde.

Q. When the Moone is 20. daies old, vpon what point of the compasse will she be at 2. of the clocke in the after none?

2. A. I place the Index of the Sun vpon the bowe 2. noted in the compasse, there holding the same without mouing, then I turne the Index of the Moone, vntil I bring it vnto the 20. day of her age, and there I see vpon the Compasse that she is North east and by North, and 15. minutes to the Northward, at 2. of the clocke in the afternoone, when she is 20. daies old.

To finde the Moones age by this Instrument,

Q. When the Moone is North at 7. of the clocke in the fore noone, how old is she?

1. A. In this question the point of the Compasse and the hower is given for the finding of the Moones age; therefore I set the Index of the Sunne vpon the bowe 7. in the fore noone; there holding it without mouing, then I bring the Index of the Moone to the point South, and then vpon the Diall containing the daies of the Moones age, I see the Moone is 18. daies and about 18. howers old, when she is North at 7. of the clocke in the fore noone.

Q. When the Sunne is East and the Moone South west, how olde is the Moone?

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12. A. In this question the points of the Compass are onely given for the finding of the Moones age, therefore I set the Index of the Sunne upon the point East, there holding him steadie, then I put the Index of the Moone upon the point South west, and there I see that the Moone is 18 daies and 18 howers old, when the Sunne is East and the South west.

After this order by the varietie of these few questions, you may frame unto your selfe many other pleasant & necessary questions, which are very easily answered by this Instrument: and entering into the reasons of their answers, you may very readily by a little practise, be able by memory to answer all such questions with ease.

How to know the time of your tides by this Instrument.

1. Q. When the Moone is 1. daies olde, I desire to know the time of full sea at London.

1. A. To answer this question, I first looke through all the pointes of the Compass of my instrument, untill I finde where London is written, for when the Moone cometh upon that point of the Compass, it will then be full sea at London: therefore I place the index of the Moone upon the same point, which I finde to be South west 21. North east, there holding the Index not to be moved, then I turne the Index of the Sunne untill I bring the twelfth day of the Moones age to the Index of the Moone, and when the Index of the Sunne sheweth me that at 12. of the clocke 36. minutes past, it is full sea at London the Moone being 12. daies olde.

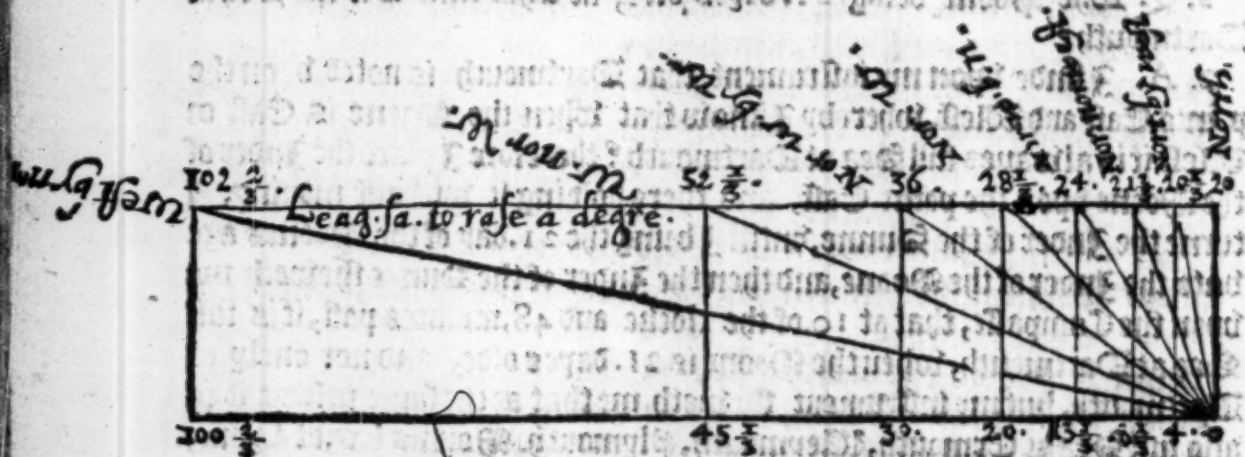
2. Q. The Moone being 21. daies olde, at what time is it full Sea at Dartmouth?

2. A. I finde upon my instrument, that Dartmouth is noted upon the point East and West, where by I know that when the Moone is East or West it is alwayes full Sea at Dartmouth: therefore I place the Index of the Moone upon the point East, and there holding it without moving, I turne the Index of the Sunne, untill I bring the 21. day of the Moones age unto the Index of the Moone, and then the Index of the Sunne sheweth me upon the Compass, that at 10. of the clocke and 48. minutes past, it is full Sea at Dartmouth, when the Moone is 21. daies olde, and not onely at Dartmouth, but my instrument sheweth me that at the same instant it is also full Sea at Exmouth, Weymouth, Plymouth, Pounts bay, at Lynne, and at Humber: and thus with great facilitie the time of flowings and reflowings is made perfectly knowne.

And now that there may be a finall ende of the vles and effectes of the Compass, it is convenient that I make knowne unto you, how many leagues shalbe sailed upon every perticular point of the Compass, for the raising or

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laying of the degrees of latitude, and in the distance sayling how farre you shall be seperated from the Meridian from whence the saide comles are begun, for as every point of the compasse hath his certain limited distance for the degrees of the Poles elevation, so do they likewise lead from longitude to longitude, every point according to his ratable limits, which distances of leagues are without alteration, keeping one & the same proportion in every particular Portion of any latitude, but the degrees of Longitude answerable to such distances, doe differ in every altitude, according to the nature of the parallel, as hereafter shall be more plainly manifested. And now to know, that in sayling North and South, you depart not from your Meridian, and in every 20. leagues sayling you raise a degree: For & by east raiseth a degree in sayling 20. leagues and one mile, and leadeth from the Meridian 4. leagues: For nor east raiseth a degree in sayling 21. leagues & two miles, leadeth from the Meridian 8. leagues & one mile: For east by north raiseth a degree in sayling 24. leagues, and leadeth from the Meridian 12. leagues & a mile: For east raiseth a degree in sayling 28. leagues & a mile, and leadeth from the Meridian 20. leagues: For east by east raiseth a degree in sayling 36. leagues, and leadeth from the Meridian 30. leagues. East nor east raiseth a degree in sayling 42. leagues and a mile, and leadeth from the Meridian 48. leagues and a mile: East & by north raiseth a degree in sayling 100. leagues and a mile, & leadeth from the Meridian 100. leagues and a mile: East and West doe not raise or lay the Pole, but keepeth still in the same parallel: the like allowance is to be given to every quarter of the Compasse, as is laide downe vpon this Northeast quarter.



Leagues seperated from the Meridian in raising a degree.

Q. I perceive that degrees are to great purpose in Navigation.

What is a degree?

Ans

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An. It is most true, that degrees are of very great imploiment in Navigation, and a degree is the 360 part of a circle, be how big or little soever the circle be, being applied after severall sortes, for the better perfections of the practises Subnautick, so that there be degrees of longitude, degrees of latitude, degrees of Azimuth, degrees of altitude, degrees applied to measure, and degrees applied to time.

A degree of longitude is the 360. part of the Equinoctiall,

A degree of latitude is the 360. part of the Meridian.

A degree of Azimuth is the 360. part of the Compasse or Horizon.

A degree of altitude is the 90. part of the verticall circle, or the 90. parte of the distance betwene the Zenith and the Horizon.

Every degree applied to measure, doth containe 60. minutes, and every minute 60. seconds, and every second 60. thirds, &c. and every degree of a great circle so applied, containeth 20. leagues, which is 60. mile so that every minute standeth for a mile in the accompt of measures, and a mile is limited to be 1000. paces, every pace 5. foote, every foote 12. inches, and every inch 3. barley cornes by and round, after our English accompt, which for the use of Navigation is the onely best of all other: so by these rates of measure you may proue that a degree is 20. leagues or 60. miles, a minute is a mile or 5000. foote, a second is 83 $\frac{1}{3}$. foote, and a third is 16 $\frac{2}{3}$. inches: and thus much of degrees and their partes applied to measure.

Of degrees applied to time, there are 15. contained in every hower, so that every degree of time standeth in the accompt of time for 4. minutes, for an hower consisting of 60. minutes of time, hath for his fiftenth part 4. minutes, so that a degree being the fiftenth part of an hower, containeth 4. minutes of time, so that 15. degrees or 60. minutes make an hower, 24. howers make a natural day, and 365. daies 6. howers, are contained in a yere, and thus much as touching time, and degrees applied to time.

What is the vse of degrees?

The vse of degrees is to measure distance betwene place and place, to find altitudes, latitudes, and longitudes, to describe countries, to distinguish courses, to finde the variation of the Compasse, to measure time, to finde the places and motions of all celestiall bodies, as the Sunne, Moone, Planets and Starres: to conclude, by degrees have bene perfourmed all Mathematicall obseruations whatsoeuer, whose vse is infinite.

What is the Poles altitude, and how it may be knowne?

Altitude is the distance, height, or mounting of one thing aboue another so that the altitude of the pole, is the distance, height, or mounting of the Pole from the Horizon, & is defined to be that portion of the Meridian, which

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is contained betwene the Pole and the Horizon, which altitude or elevation is to be found either by the Sunne, or by the fixed Starres, with the helpe of your Crosse Staffe, Quadrant, or Astrolabie, but the crosse Staffe is the onely best instrument for the Seaman's vse.

And in the obseruation of this altitude there are 5. things especially to be regarded: the first is, that you know your meridionall distance betwene your Zenith and the Sunne or Starres, which by your Crosse Staffe or Astrolabie is giuen: the second, that the declination be truly knowne at the time of your obseruation. And the other three are, that you consider whether your Zenith be betwene the Equinoctiall and the Sunne or Starres, or whether the Equinoctiall be betwene your Zenith and them, or whether they be betwene your Zenith & the Equator, for there is a severall order of working vpon each of these three differences.

Latitude you must also know, that so much as the pole is above the Horizon, so much is the Zenith from the Equinoctiall, and this distance betwene the Zenith and the Equator is called latitude or wideneffe, and is that portion of the Meridian which is included betwene your Zenith & the Equator, for it is a generall rule for euer, that so much as the Pole is above the Horizon, so much the Zenith is from the Equinoctiall, so that in this sense altitude and latitude is all one thing, the one hauing relation to that part of the Meridian contained betwene the Pole and the Horizon, and the other to that parte of the Meridian which is contained betwene the Zenith and the Equinoctiall.

You must further vnderstand, that betwene the Zenith and Horizon it is a quarter of a great circle, containing 90 degrees, so that knowing howe much the Sunne or any Starre is from the Horizon, if you take that distance from 90. the remainder is the distance betwene the said body and the Zenith, as for example, if the Sunne be 40. degrees 37. minutes from the Horizon, I substract 40. degr. 37. min. from 90. and there remaineth 49. deg. 23. min. which is the distance betwene my Zenith and the Sunne, &c. Those instruments that begin the account of their degrees at the Zenith concluding 90. in the Horizon, are of most ease of the finding of the latitude by the Sunne or fixed Stars, because they giue the distance betwene the Zenith and the body obserued, without further trouble, and that is the number which you must haue, and so: which you do search in your obseruation: At which things considered, you must in this sort proceede to: the finding of the Poles height or altitude.

By the Sun or fixed Stars being betwene your Zenith and the Equinoctiall the latitude is thus found, in what part of the world soeuer you be. A
First place the Crosse staffe to your eye, in such good sorte as that there may growe no error by the obliquity of the staffe, for vntill the Center

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ter of your staffe and the center of your sight doe ioyne together in your obseruation, it will be erroneous whatsoeuer you conclude thereby: your staffe so ordered, then moue the transuersary vpon your staffe to and fro as occasion requireth, vntill at one & the same instant you may see by the upper edge of your transuersary halfe the body of the Sunne or Stars, and that the lower edge or end thereof do likewise touch the Horizon, at that place where it seemeth that the Skie and seas are ioyned, hauing especiall regarde in this your obseruation, that you hold the transuersary as directly bright as possibly you may, and you must begin this obseruation somewhat before the Sun or Starres be at South, and continue the same so long as you perceiue that they rise: for when they are at the highest then are they vpon the Meridian, and then you haue the meridionall altitude which you seek, at which time they will be due South from you, if your Compasse be good and without variation, and then both the transuersary shew vpon the staffe the degrees and minutes that the sayd body is from your Zenith, if \varnothing degrees of your instrument be numbred from the Zenith toward the Horizon: or else it sheweth the distance betwene the said body & the Horizon, if the degrees of your instrument be numbred from the Horizon, concluding 90° . in the Zenith as commonly Crosse staves are marked, which is not the easiest way: but if your staffe be accompted from the Horizon, then subtract the degrees of your obseruation from 90° . & the remainder sheweth the distance betwene your Zenith and the Sunne or Stars, which is the number you must know: vnto that number so known by your instrument, adde the declination of the body by which you do obserue, whether it be the Sun or any star, and that which cometh by the addition of those 2. numbers together is the poles height, or the latitude of the place wherein you are: as for example. In the yere of our Lord 1593. the third day of March, the Sunne being then betwene my Zenith and the Equinotiall, I obserued the Sunnes Meridionall altitude from the Horizon to be 72° . deg. and 20 min. but because I must knowe the distance of the Sun from my Zenith, I therefore subtract 72° . deg. 20. min. from 90° . deg. and there remaineth 17° . deg. 40. min. the distance of the Sun from my Zenith, to that distance I adde the Suns declination for that day, which by my Regiment I finde to be 3. degrees of South declination, and it amounteth vnto 20° . deg. 40. min. so much is the South pole aboue the Horizon, and so much is my Zenith south from the Equinotiall, because the Sun hauing South declination, and being betwene me and the Equinotiall, therefore of necessitie the Antactick pole must be aboue my Horizon.

89—60—the distance betwene
the Zenith and the Horizon.

72—20—the Sunnes altitude.

17—40—the Suns dist. frō the Zen.

3—00—Sunnes declination.

20—40—Poles height.

When

The Seaman's Secrets.

When the Equinoctiall is betweene your Zenith and the Sun or Starres,
the altitude is thus found in all places.

By your instrument as before is taught, you must seek the meridional distance of the Sun or Starres from your Zenith, which being knowne, subtract the declination of the Sun or Stars from the said distance, and the remaining number is the poles height or latitude which you seek: Example.

The 20. of October 1593. I find by my instrument that the Sun is 60. deg. 45. min. from my Zenith at none, being then vpon the meridian, the Equator being then betweene my Zenith and the Sun, I also find by my Regiment that at that time the Sun had 13. deg. 47. min. of South declination, because the Equinoctiall is betweene me and the Sun, therefore I subtract the Suns declination from the obserued distance, and there resteth 46. deg. 58. min. the latitude desired, and because the Sun hath south declination, and the Equinoctiall being betweene me and the Sun, therefore I may conclude, that the pole Artick is 46. deg. 58. min. above my Horizon, or that my Zenith is somuch toward the North from the Equator.

g m

60—45—the Sunnes distance.

13—47—the declination.

46—58—the latitude.

When your Zenith is betweene the Sonne or Stars and the Equinoctiall,
the Latitude is thus found.

By your instrument as in the first example is shewed, you must obserue the meridional distance of the Sunne or Starres from your Zenith, you must also by your Regiment or other tables, search to know the declination of that body which you obserue, then subtract the obserued distance from your Zenith out of the declination, and the remaining number is the latitude desired: Example. The Sun hauing 20. deg. of North declination, and being vpon the Meridian is 5. deg. 9. min. from my Zenith, I therefore subtract 5. deg. 9. min. from 20. deg. and there resteth 14. deg. 51. min. the latitude desired: and because the Sun hath North declination, my Zenith being betweene the Sun and the Equinoctiall, therefore I conclude that the North pole is 14. deg. 51. min. above my Horizon.

g m

20—05—the declination,

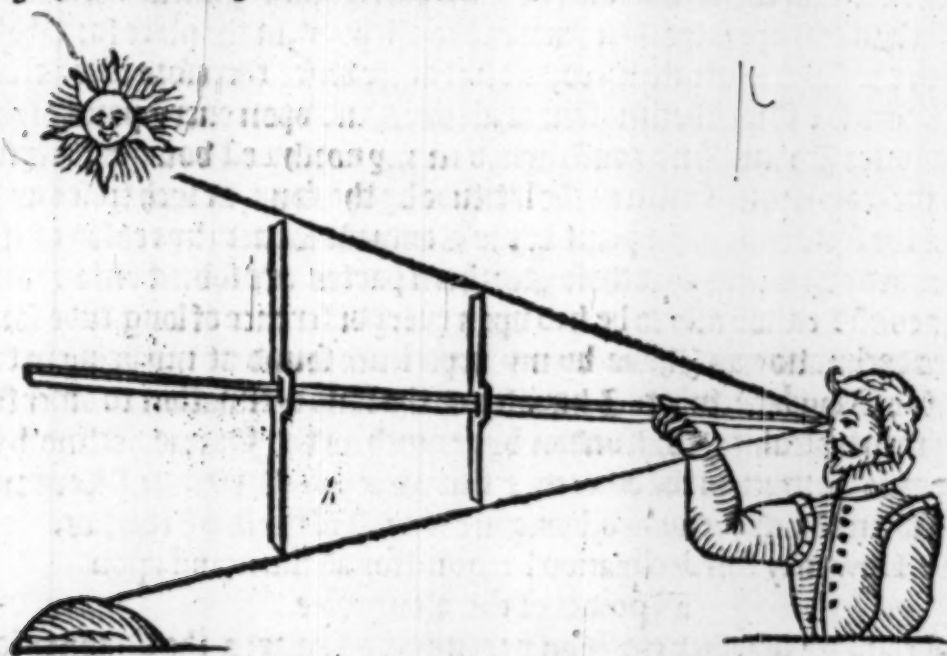
5—09—the Suns distance from my Zenith.

14—51—the Poles height.

The Seamans Secrets.

How shall I know the true order of placing the Crosse staffe to mine eye,
to auoyde error in my obseruation?

To finde the true placing of the staffe at your eye thereby to amend the
parallax or false shadow of your sight, do thus: take a staffe hauing two
crosses, a long crosse which endeth in 30. degrees, and a short crosse which be-
ginneeth at 30. deg. where the long crosse endeth, put the long crosse vpon his
30. deg. and there make him fast, then put the short crosse likewise vpon his
30. deg. there fasten him without mouing, then let the ende of your staffe to
your eye, incuing it from place to place about your eye, vntill at one instant
you may see the ends of both crosses, which when you finde, remember that
place and the standing of your body, for so must your staffe be placed, & your
body ordered in all your obseruations.



Are these all the rules that appertaine to the finding
of the Poles height?

Those that trauell farre towards the north vnder whose Horizon the
Sunne setteth not, shall some time haue occasion to seeke the latitude
by the Sunne when the Sunne is north from them, the pole being then be-
tween the Sunne and their Zenith. When such obseruations are made, you
must by your instrument seeke the Suns height from the Horizon, subtract
that height from his declination, and the remaining number sheweth how
far the Equinoctiall is vnder the Horizon vpon the point north, for so much
is the opposite part of the Equator above the Horizon vpon the point South,
subtract that Meridionall latitude of the Equinoctiall from 90. and the re-
maining number is the poles height desired: Example.

The Seaman's Secrets.

The Sunne hauing 22. degrees of North declination, his altitude from the Horizon is obserued to be 3. degrees 15. minutes, therefore subtracting 3. deg. 15. min. from 22. degrees, there resteth 18. deg. 45. min. which is the distance of the Equinotiall from the horizon, which being taken from 90. there resteth 71. deg. 15. min. the poles elevation desired.

d	m	
22	— 00	the Suns declinations.
3	— 15	the Sunnes altitude,
18	— 45	the altitude of the equi-
		nodiall

d	m	
89	— 60	the dist. between zen. & Hor.
18	— 45	altitude of the Equator.
71	— 15	the altitude of the pole.

But you must know that the declination found in your Regiment is not the declination which in this case you must vse: for the regiment sheweth the Sun's declination vpon the Meridian or South point, in the place for whose Meridian the same was calculated, and not other wise: therefore it is necessary to know the Sun's declination at all times, and vpon euery point of the Compasse: for I haue bene constrained in my north west voyages, being within the frozen zone, to search the latitude by the Sun, at such times as I could see the sun, vpon what point of the Compasse soeuer, by reason of the great fogges and mists that those Northern partes are subiect vnto: and there is consideration also to be had vpon euery difference of longitude for the Sunnes declination, as I haue by my experience found at my being in the Straights of Magilane, where I haue found the suns declination to differ from my regiment calculated for London, by so much as the Sunne declineth in 5. houers, for so much is the difference betwene the Meridian of London & the Meridian of Cape froward, being in the midst of the said Straights.

How may this declination be found for all times, and vpon
all points of the Compasse?

First consider whether the Sun be comming toward the Equinotiall, for going from him, that being known, consider the time wherein you seeke the declination, then looke for the Sunnes declination in your regiment for that day, & also seeke his declination for the next day, subtrad the lesser out of the greater, and the remainder is the whole declination which the Sunne declineth in 24. houers, or in his moving through all the points of the Compasse, from which number you may by the rule of proportion find his declination vpon euery point of the compas or for euery houre of the day as by these examples may appeare: Example: In the yere 1593. the 20. of March, I desire to know the Sun's declination when he is vpon the North part of the Meridian of London, I seeke the Sun's declination for that day, and find it to be 3. deg. 41. min. the Sunne then going from the Equator, I also search his declination for the next day being the 21. of March, & find it to be 4. deg. 3. min. I then subtract 3. deg. 41. min. from 4. de. 3. min. & there resteth 12. min.

The Seaman's Secrets.

min. so much the Sun hath declined in 24. howeres, or in going through all the points of the Compass. Then I say by the rule of proportion, if 24. howeres give 22. min. of declination what will 12. howeres give, &c. I multiply and divide, and find it to be 11. min. the Sunnes declination in 12. howeres motion to be added to the declination of the 20. day, being the Sunnes going from the Equator, or for the points of the Compass I may say, if 32. points give 22. min. of declination. what will 16. points give, which is the distance betwene South and North: I multiply and divide as the rule of proportion requireth, & find that 16. points give 11. min. the Sun's declination, in moving through 16. points of the Compass, which is to be added to the declination of the 20. day, because the Sun goeth from the Equator, so I conclude the declination to be 3. deg. 52. min. the Sun being North the 20. of March.

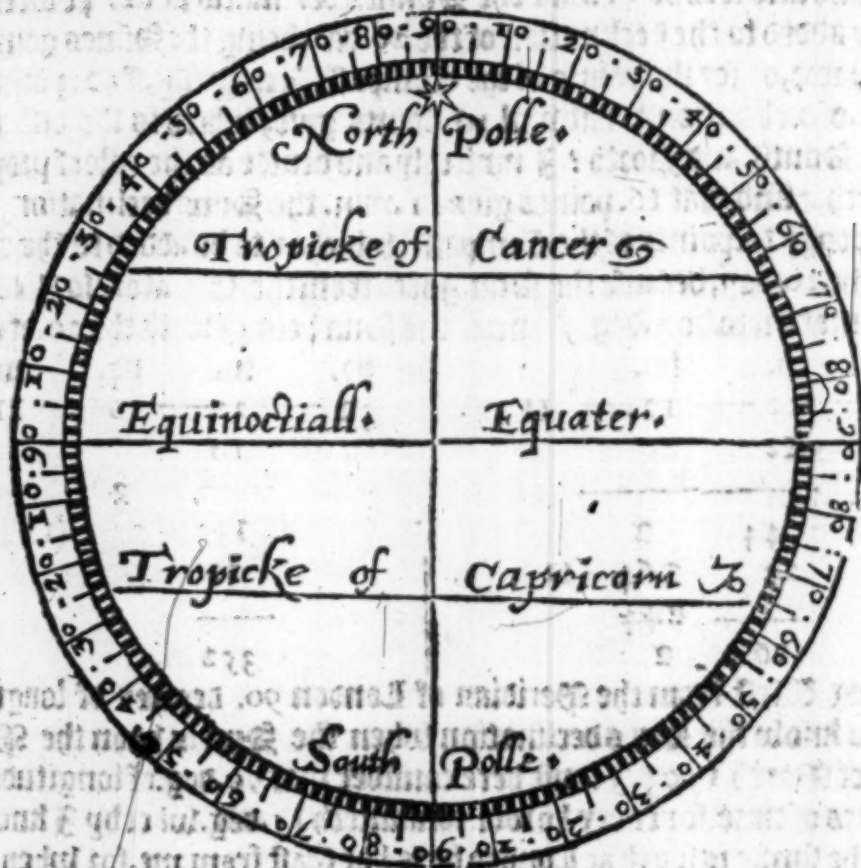
ho.	m.	ho.	pr.	m.	po.	m.
24	22	12	32	22	16	11
	12			16		
	44	2			3	
	22	264		132	352	(11
		244		22	322	
	264	2			3	
				352		

Being West from the Meridian of London 90. degrees of longitude, I desire to know the Sun's declination when the Sun is upon the Meridian the 20. of March 1593. I must here consider that 90. deg. of longitude make 6. howeres of time, for every hower containeth 15. deg. wherby I know that when the sunne is south at London he is but East from me, for when it is 12. of the clocke at London, it is but 6. of the clocke in the morning with me, & when it is 12. of the clocke with me, it is then 6. of the clocke in the afternoon at London: therefore I must take for the declination of the sunne at 6. of the clocke in the afternoon, and that is the meridionall declination which I must use, being 90. deg. West from London, which to doe, the last example doth sufficiently teach you, wherby you may easily gather the perfect note of whatsoever is requisite in any of these kinde of observations, if you reade with the eye of reason, and labour to understand with iudgement that which you reade.

There is another way most excellent for the finding of the Sunnes declination at all times, that is to search by the Ephemerides the Sunnes true place in the Celiptick for any time purposed whatsoever, and then by the tables of Sinus the declination is thus known. Multiply the Sinus of the suns longitude from the Equinodial points of Aries or Libra, to which soever he is nearest, by the Sinus of the Sun's greatest declination, and divide the product by the whole Sinus, and the arke of the quotient is the declination desired.

The Seamans Secrets.

red: but because Seamen are not acquainted with such calculations, I therefore I omit to speake further thereof, with this plaine way before taught is sufficient for their purpose.



The vse of this Instrument.

By this instrument you may sufficiently understand, the reasons of what before is before spoken for the finding of the Poles elevation, or the latitude of your being: into the consideration whereof, because the young practitioner may the better enter, I thinke it not amisse by a few examples to expresse the necessary use thereof.

1. Q. The Sunne having 7. degrees of north declination, and the Pole Artick being 45. degrees above the Horizon. I demaund what will be the Sunnes meridionall distance from my Zenith?

1. A. First I turne the Horizon untill I bring the north pole to be 45. degrees above the same, there holding the Horizon not to be moved, I then bring the thrid that is fastened to the Center of the Instrument, 7. degrees from the Equinoctiall towards the north, because the Sunne hath so much north declination, and the thrid doth shew me upon the verticall circle, that the Sunne is 38. degrees from my Zenith.

2. Q. The

The Seaman's Secrets:

2.Q. The pole artick being 50. deg. above the Horizon, and the Sun's distance 30. deg. from the Zenith, I demaund what is the Sun's declination?

2.A. As in the first question I place the North pole 5. degrees above the Horizon, there holding the Horizon not to be moved, then I bring the thrid to the 30. degree upon the verticall circle, because the Sun is 30. degrees from my Zenith, and then the thrid sheweth upon the Meridian betwene the Tropick of Cancer and the Equinoctiall, that the Sunne hath 20. degrees of North declination.

3.Q. The Sunne hauing 10. deg. of South declination, being upon the Meridian, is 3. deg. from my Zenith, I demaund what is the poles height?

3.A. In the first question the Poles height and the Sunnes declination are giuen for the finding of the Sunnes meridionall distance from the Zenith. In the second the Poles height is giuen, and the Sunnes meridionall distance from the Zenith, thereby to find the Sun's declination. And in this question the Sunnes declination and meridionall distance is giuen for the finding of the Poles height. I therefore bring the thrid fastned in the center of the instrument 10. degrees South from the Equator, between the Equinoctiall and the tropick of Capricorne, there holding the thrid not to be moued, I then turne the Horizon untill I bring the 53. degree of the verticall circle vnder the thrid, and then the Horizon sheweth mo. that the North pole is 43. degrees above the same.

4.Q. The Sun hauing 12. degrees of South declination and being upon the Meridian South from me, is 20. degrees above the Horizon, I demaund how farre the Sun is from my Zenith, how much the Equinoctiall is above the Horizon and what is the Poles height.

4.A. First I bring the thrid to the place of the Sunnes declination as before, there holding it not to be moued, then I turne the Horizon untill I bring it to be 30. deg. vnder the thrid, & then the thrid sheweth me that the Sun is 60. deg. from my Zenith and the Horizon sheweth that the Equinoctiall is 42. deg. above the same, & that the north pole is also eleuated 48. deg. above the horizon. Although these questions are so very easy and plain, as that they may readily be answered by memory, yet because the reasons how they are answered may the better appeare, is the cause wherefore they are demanded & in this sort answered, only for the benefit of such as are not altogether expert in these practises, that thereby they might likewise frame vnto themselves questions of other variety and so gather thereby the more sufficient iudgement in this part of Nauigation.

What is the Zenith?

The Zenith is that prick or point in the heauens which is directly ouer your head, from whence a line falling perpendicularly, will touch the place of your being, & so passe by the center of the sphere, and this line may be called the Axis of the Horizon and the Zenith the pole of the same being 90. deg.

The Seamans Secrets,

The use of the Regiment.



Enasmuch as the poles height cannot be obserued by the Sunne, vnlesse the Sunnes true declination be knowne, I haue therefore carefully calculated these Tables or Regiment, out of *Stadius Ephimerides*, for the yeeres 1593, 94, 95. and 1596. which will serue vntill the yeere 1612. without further correction: and because there may grow no error by mistaking the yeeres, I haue ouer euery moneth writen the yeere of the Lord, in which the declination of the same month is to be vsed, therefore when in any yeere and moneth you seeke the Sunnes delination, first looke for the moneth, and there you shall find 4. of those moneths, which are the moneths betweene the leape yeeres, then looke ouer each of those moneths, vntill you find the yeere of the Lord wherein you seeke the declination, and directly vnder that yere is the moneth wherein you must seeke the Suns declination. Example, 1595. the tenth day of February I would know the Suns declination, first I seeke out February, and ouer the third moneth I see the yeere 1595. therefore that is my moneth, against the tenth day of which moneth I find that the sunne hath 11. degrees 10. minutes of South declination, and after the like manner you must do in all the rest as occasion requireth:

Januarie

January 7

First.		Second.		Third.		Fourth.	
1		2		3		4	
1593		1594		1595		1596	
1597		1598		1599		1600	
1601		1602		1603		1604	
1605		1606		1607		1608	
1609		1610		1611		1612	
D. G. M.		D. G. M.		D. G. M.		D. G. M.	
1 21 90		1 21 52		1 21 56		1 21 57	
2 21 46		2 21 43		2 21 39		2 21 48	
3 21 39		3 21 36		3 21 36		3 21 38	
4 21 29		4 21 23		4 21 26		4 21 28	
5 21 19		5 21 16		5 21 15		5 21 17	
6 20 58		6 20 51		6 20 49		6 20 57	
7 20 47		7 20 50		7 20 53		7 20 55	
8 20 34		8 20 38		8 20 41		8 20 44	
9 20 22		9 20 26		9 20 29		9 20 32	
10 20 9		10 20 13		10 20 16		10 20 20	
11 19 56		11 19 41		11 19 31		11 19 16	
12 19 43		12 19 47		12 19 50		12 19 53	
13 19 29		13 19 33		13 19 36		13 19 33	
14 19 14		14 19 19		14 19 22		14 19 25	
15 19 0		15 19 4		15 19 8		15 19 11	
16 18 45		16 18 49		16 18 35		16 18 56	
17 18 29		17 18 34		17 18 38		17 18 41	
18 18 14		18 18 19		18 18 22		18 18 26	
19 17 58		19 18 3		19 18 7		19 18 11	
20 17 42		20 17 46		20 17 50		20 17 54	
21 17 25		21 17 30		21 17 34		21 17 38	
22 17 8		22 17 13		22 17 17		22 17 21	
23 16 51		23 16 56		23 17 0		23 17 4	
24 16 32		24 16 38		24 16 43		24 16 47	
25 16 16		25 16 21		25 16 25		25 16 29	
26 15 57		26 16 2		26 16 7		26 16 12	
27 15 39		27 15 45		27 15 46		27 15 54	
28 15 21		28 15 26		28 15 30		28 15 35	
29 15 2		29 15 7		29 15 12		29 15 23	
30 14 43		30 14 48		30 14 53		30 14 58	
31 14 24		31 14 29		31 14 34		31 14 39	

South declination,

South declination,

South declination,

February.

First.	Second.	Third.	Fourth.
1	2	3	4
1593	1594	1595	1596
1597	1598	1599	1600
1601	1602	1603	1604
1605	1606	1607	1608
1609	1610	1611	1612
D. G. M.	D. G. M.	D. G. M.	D. G. M.
1 14 4	1 14 9	1 14 14	1 14 19
2 13 44	2 13 50	2 13 54	2 14 0
3 13 24	3 13 29	3 13 35	3 13 40
4 13 4	4 13 9	4 13 15	4 13 20
5 12 44	5 12 49	5 12 54	5 13 0
6 12 23	6 12 28	6 12 34	6 12 39
7 12 2	7 12 7	7 12 13	7 12 18
8 11 41	8 11 46	8 11 52	8 11 58
9 11 20	9 11 25	9 11 31	9 11 37
10 10 58	10 10 4	10 10 10	10 10 15
11 10 37	11 10 43	11 10 48	11 10 54
12 10 15	12 10 21	12 10 26	12 10 33
13 9 53	13 9 59	13 10 5	13 10 11
14 9 31	14 9 37	14 9 43	14 9 49
15 9 9	15 9 15	15 9 21	15 9 27
16 8 47	16 8 53	16 8 59	16 9 5
17 8 25	17 8 30	17 8 36	17 8 43
18 8 3	18 8 7	18 8 13	18 8 20
19 7 26	19 7 45	19 7 50	19 7 58
20 7 06	20 7 32	20 7 38	20 7 35
21 6 53	21 6 59	21 7 5	21 7 12
22 6 30	22 6 36	22 6 42	22 6 49
23 6 7	23 6 13	23 6 19	23 6 26
24 5 44	24 5 50	24 5 56	24 6 4
25 5 21	25 5 27	25 5 32	25 5 40
26 4 58	26 4 5	26 5 9	26 5 17
27 4 34	27 4 40	27 4 46	27 4 54
28 4 10	28 4 37	28 4 22	28 4 30
29 3 52	29 3 58	29 3 54	29 4 7
30 3 33	30 3 39	30 3 45	30 3 53
31 3 14	31 3 20	31 3 26	31 3 34

South
declina-
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South
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South
declina-
tion.

March.

First.	Second.	Third.	Fourth.
1	2	3	4
1593	1594	1595	1596
1597	1598	1599	1600
1601	1602	1603	1604
1605	1606	1607	1608
1609	1610	1611	1612
D.G.M.	D.G.M.	D.G.M.	D.G.M.
1 3 47	1 3 53	1 3 59	1 3 43
2 3 24	2 3 29	2 3 35	2 3 19
3 3 0	3 3 6	3 3 12	3 2 56
4 2 36	4 2 42	4 2 48	4 2 32
5 2 13	5 2 18	5 2 25	5 2 9
6 1 49	6 1 55	6 2 1	6 1 45
7 1 25	7 1 31	7 1 37	7 1 22
8 1 2	8 1 11	8 1 14	8 0 59
9 0 39	9 0 47	9 0 50	9 0 34
10 0 15	10 0 20	10 0 26	10 0 11
11 0 8	11 0 3	11 0 3	11 0 12
12 0 32	12 0 27	12 0 21	12 0 36
13 0 56	13 0 51	13 0 44	13 0 59
14 1 19	14 1 14	14 1 8	14 1 23
15 1 43	15 1 37	15 1 31	15 1 46
16 2 6	16 2 1	16 1 55	16 2 10
17 2 30	17 2 24	17 2 18	17 2 33
18 2 54	18 2 48	18 2 41	18 2 56
19 3 17	19 3 11	19 3 5	19 3 20
20 3 41	20 3 34	20 3 28	20 3 43
21 4 3	21 3 57	21 3 53	21 4 6
22 4 26	22 4 21	22 4 15	22 4 29
23 4 50	23 4 44	23 4 38	23 4 52
24 5 13	24 5 7	24 5 1	24 5 15
25 5 36	25 5 30	25 5 24	25 5 38
26 5 59	26 5 52	26 5 42	26 6 1
27 6 21	27 6 15	27 6 10	27 6 23
28 6 44	28 6 38	28 6 32	28 6 46
29 7 6	29 7 1	29 6 55	29 7 8
30 7 29	30 7 23	30 7 18	30 7 30
31 7 51	31 7 46	31 7 40	31 7 52

South
declina-
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South
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South
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North
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North
declina-
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North
declina-
tion.

April M

First.	Second	Third	Fourth.
1 st	2 ^d	3 ^d	4 th
13231	15208	15252	15206
15271	15282	15292	16000
16031	16020	16030	16040
18051	16060	96020	16080
16091	16100	16110	16120
D.G.M.	D.G.M.	D.M.M.	D.G.M.
1 8 13	1 8 13	1 8 10	1 8 15
2 8 15	2 8 20	2 8 25	2 8 25
3 8 17	3 8 52	3 8 47	3 8 47
4 9 19	4 9 14	4 9 9	4 9 9
5 9 41	5 9 136	5 9 30	5 9 41
6 10 2	6 9 57	6 9 52	6 10 2
7 10 23	7 10 13	7 10 13	7 10 13
8 10 44	8 10 10	8 10 34	8 10 44
9 11 5	9 11 1	9 10 55	9 11 5
10 11 25	10 11 21	10 11 16	10 11 25
11 11 45	11 11 42	11 11 36	11 11 46
12 12 6	12 12 1	12 11 56	12 12 6
13 12 26	13 12 22	13 12 10	13 12 26
14 12 46	14 12 45	14 12 36	14 12 46
15 13 6	15 13 3	15 12 56	15 13 5
16 13 25	16 13 23	16 13 16	16 13 25
17 13 44	17 13 42	17 13 35	17 13 44
18 14 4	18 14 1	18 13 55	18 14 3
19 14 22	19 14 20	19 14 14	19 14 22
20 14 41	20 14 38	20 14 32	20 14 40
21 14 59	21 14 58	21 14 51	21 14 59
22 15 17	22 15 15	22 15 9	22 15 17
23 15 35	23 15 33	23 15 27	23 15 35
24 15 53	24 15 50	24 15 45	24 15 52
25 16 10	25 16 8	25 16 2	25 16 9
26 16 27	26 16 25	26 16 19	26 16 27
27 16 44	27 16 42	27 16 36	27 16 43
28 17 1	28 16 58	28 16 53	28 17 0
29 17 12	29 17 9	29 17 9	29 17 16
30 17 32	30 17 38	30 17 26	30 17 32
31 17 51	31 17 51	31 17 11	31 17 51

North
declina-
tion,

North
declina-
tion,

North
declina-
tion,

May.

First.	Second.	Third.	Fourth.
1	2	3	4
1593	1594	1595	1596
1597	1598	1599	1600
1601	1602	1603	1604
1605	1606	1607	1608
1609	1610	1611	1612
D.G.M.	D.G.M.	D.G.M.	D.G.M.
1 17 49	1 17 45	1 17 41	1 17 48
2 17 57	2 18 1	2 17 57	2 18 3
3 18 12	3 18 16	3 18 12	3 18 18
4 18 27	4 18 31	4 18 27	4 18 33
5 18 41	5 18 45	5 18 45	5 18 48
6 18 56	6 19 0	6 18 56	6 19 2
7 19 9	7 19 13	7 19 10	7 19 16
8 19 23	8 19 27	8 19 23	8 19 29
9 19 36	9 19 40	9 19 38	9 19 42
10 19 49	10 19 53	10 19 50	10 19 56
11 20 2	11 20 6	11 20 3	11 20 8
12 20 14	12 20 17	12 20 15	12 20 20
13 20 26	13 20 30	13 20 27	13 20 32
14 20 38	14 20 41	14 20 39	14 20 43
15 20 46	15 20 53	15 20 50	15 20 54
16 21 0	16 21 4	16 21 1	16 21 7
17 21 10	17 21 14	17 21 11	17 21 16
18 21 20	18 21 24	18 21 22	18 21 26
19 21 30	19 21 34	19 21 32	19 21 35
20 21 39	20 21 43	20 21 41	20 21 45
21 21 49	21 21 52	21 21 50	21 21 54
22 21 57	22 22 0	22 21 59	22 22 2
23 22 6	23 22 8	23 22 7	23 22 10
24 22 14	24 22 16	24 22 15	24 22 18
25 22 21	25 22 24	25 22 22	25 22 25
26 22 28	26 22 31	26 22 30	26 22 33
27 22 35	27 22 37	27 22 36	27 22 39
28 22 41	28 22 43	28 22 42	28 22 45
29 22 47	29 22 49	29 22 48	29 22 51
30 22 52	30 22 54	30 22 53	30 22 57
31 22 57	31 23 0	31 22 58	31 23 1

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June.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593			1594			1595			1596		
1597			1598			1599			1600		
1601			1602			1603			1604		
1605			1606			1607			1608		
1609			1610			1611			1612		
D. G. M.			D. G. M.			D. G. M.			D. G. M.		
1	23	4	1	23	4	1	23	3	1	23	0
2	23	9	2	23	8	2	23	7	2	23	10
3	23	13	3	23	12	3	23	11	3	23	13
4	23	16	4	23	16	4	23	15	4	23	17
5	23	19	5	23	19	5	23	18	5	23	20
6	23	22	6	23	21	6	23	21	6	23	22
7	23	24	7	23	23	7	23	23	7	23	24
8	23	26	8	23	25	8	23	25	8	23	26
9	23	27	9	23	26	9	23	26	9	23	27
10	23	28	10	23	27	10	23	27	10	23	28
11	23	28	11	23	28	11	23	28	11	23	28
12	23	28	12	23	28	12	23	28	12	23	28
13	23	28	13	23	28	13	23	28	13	23	28
14	23	27	14	23	27	14	23	27	14	23	26
15	23	26	15	23	26	15	23	26	15	23	25
16	23	24	16	23	25	16	23	25	16	23	23
17	23	22	17	23	23	17	23	23	17	23	21
18	23	19	18	23	20	18	23	21	18	23	18
19	23	16	19	23	17	19	23	18	19	23	15
20	23	13	20	23	14	20	23	15	20	23	12
21	23	9	21	23	10	21	23	11	21	23	8
22	23	5	22	23	6	22	23	7	22	23	4
23	23	1	23	23	2	23	23	4	23	23	59
24	22	56	24	22	57	24	22	58	24	22	54
25	22	51	25	22	52	25	22	53	25	22	49
26	22	45	26	22	46	26	22	48	26	22	43
27	22	38	27	22	40	27	22	41	27	22	39
28	22	32	28	22	34	28	22	35	28	22	30
29	22	25	29	22	27	29	22	26	29	22	23
30	22	18	30	22	20	30	22	21	30	22	15

North
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First.	Second.	Third.	Fourth.
1	2	3	4
1593	1594	1595	1596
1597	1598	1599	1600
1601	1602	1603	1604
1605	1606	1607	1608
1609	1610	1611	1612
D.G. M.	D.G. M.	D.G. M.	D.G. M.
1 22 10	1 22 12	1 22 21	1 22 12
2 22 3	2 22 4	2 22 6	2 22 4
3 21 54	3 21 56	3 21 58	3 21 56
4 21 45	4 21 47	4 21 49	4 21 47
5 21 35	5 21 38	5 21 40	5 21 38
6 21 26	6 21 28	6 21 30	6 21 28
7 21 16	7 21 19	7 21 21	7 21 19
8 21 6	8 21 6	8 21 11	8 21 2
9 20 55	9 20 58	9 21 0	9 20 52
10 20 44	10 20 47	10 20 49	10 20 40
11 20 33	11 20 36	11 20 38	11 20 29
12 20 23	12 20 24	12 20 26	12 20 17
13 20 9	13 20 12	13 20 14	13 20 5
14 19 57	14 20 0	14 20 6	14 19 52
15 19 44	15 19 47	15 19 49	15 19 4
16 19 31	16 19 34	16 19 36	16 19 27
17 19 17	17 19 20	17 19 23	17 19 13
18 19 4	18 19 7	18 19 10	18 18 59
19 18 42	19 18 53	19 18 56	19 18 45
20 18 35	20 18 38	20 18 43	20 18 31
21 18 21	21 18 24	21 18 28	21 18 16
22 18 6	22 18 9	22 18 13	22 18 1
23 17 51	23 17 54	23 17 58	23 17 47
24 17 35	24 17 38	24 17 42	24 17 30
25 17 19	25 17 23	25 17 26	25 17 14
26 17 3	26 17 6	26 17 11	26 16 58
27 16 47	27 16 50	27 16 55	27 16 42
28 16 30	28 16 33	28 16 38	28 16 25
29 16 13	29 16 17	29 16 21	29 16 8
30 15 56	30 16 0	30 16 4	30 15 51
31 15 39	31 15 42	31 15 47	31 15 33

North
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August.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593			1594			1595			1596		
1597			1598			1599			1600		
1601			1602			1603			1604		
1605			1606			1607			1608		
1609			1610			1611			1612		
D. G. M.			D. G. M.			D. G. M.			D. G. M.		
1	15	21	1	15	25	1	15	30	1	15	15
2	15	3	2	15	7	2	15	12	2	14	57
3	14	45	3	14	49	3	14	54	3	14	39
4	14	27	4	14	31	4	14	36	4	14	20
5	14	8	5	14	12	5	14	18	5	14	2
6	14	49	6	13	53	6	13	59	6	13	43
7	13	50	7	13	34	7	13	40	7	13	24
8	13	9	8	13	15	8	13	2	8	13	5
9	12	51	9	12	56	9	13	2	9	12	41
10	12	31	10	12	36	10	12	42	10	12	25
11	12	12	11	12	16	11	12	23	11	12	5
12	11	52	12	11	56	12	12	3	12	11	45
13	11	32	13	11	36	13	11	42	13	11	25
14	11	11	14	11	16	14	11	22	14	11	4
15	10	51	15	10	59	15	11	2	15	10	44
16	10	30	16	10	35	16	10	41	16	10	23
17	10	9	17	10	14	17	10	20	17	10	2
18	9	5	18	9	53	18	9	59	18	9	41
19	9	27	19	9	31	19	9	39	19	9	19
20	9	5	20	9	10	20	9	16	20	8	58
21	8	44	21	8	49	21	8	55	21	8	35
22	8	22	22	8	27	22	8	33	22	8	15
23	8	0	23	8	5	23	8	11	23	7	53
24	7	38	24	7	43	24	7	50	24	7	31
25	7	16	25	7	21	25	7	28	25	7	9
26	6	53	26	6	59	26	7	5	26	6	47
27	6	31	27	6	36	27	6	43	27	6	25
28	6	9	28	6	14	28	6	20	28	6	1
29	5	46	29	5	51	29	5	57	29	5	39
30	5	23	30	5	29	30	5	31	30	5	16
31	5	0	31	5	6	31	5	12	31	4	53

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September.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593			1594			1595			1596		
1597			1598			1599			1600		
1601			1602			1603			1604		
1605			1606			1607			1608		
609			1610			1611			1612		
U. G. M.			D. G. M.			D. G. M.			D. G. M.		
1	4	38	1	4	42	1	4	49	1	4	43
2	4	14	2	4	20	2	4	26	2	4	20
3	3	51	3	3	56	3	4	3	3	3	57
4	3	28	4	3	33	4	3	39	4	3	34
5	3	5	5	3	10	5	3	16	5	3	12
6	2	37	6	2	47	6	2	53	6	2	47
7	2	18	7	2	23	7	2	29	7	2	24
8	1	55	8	2	0	8	2	6	8	2	1
9	1	31	9	1	37	9	1	43	9	1	37
10	1	8	10	1	13	10	1	19	10	1	14
11	0	45	11	0	49	11	0	56	11	0	51
12	0	21	12	0	26	12	0	32	12	0	27
13	0	2	13	0	3	13	0	9	13	0	31
14	0	25	14	0	11	14	0	15	14	0	20
15	0	48	15	0	44	15	0	38	15	0	43
16	1	12	16	1	8	16	1	2	16	1	71
17	1	35	17	1	31	17	1	25	17	1	50
18	1	58	18	1	55	18	1	48	18	1	54
19	2	22	19	2	18	19	2	12	19	2	17
20	2	45	20	2	45	20	2	35	20	2	41
21	3	9	21	3	5	21	2	59	21	3	4
22	3	32	22	3	28	22	3	22	22	3	27
23	3	55	23	3	51	23	3	45	23	3	50
24	4	18	24	4	15	24	4	9	24	4	14
25	4	41	25	4	38	25	4	32	25	4	37
26	5	4	26	5	1	26	4	55	26	5	0
27	5	27	27	5	23	27	5	18	27	5	23
28	5	51	28	5	46	28	5	41	28	5	46
29	6	14	29	6	9	29	6	4	29	6	8
30	6	36	30	6	32	30	6	26	30	6	31

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October.

First.			Second.			Third.			Fourth.		
1			2			3			4		
1593			1594			1595			1596		
1597			1598			1599			1600		
1601			1602			1603			1604		
1605			1606			1607			1608		
1609			1610			1611			1612		
D. G. M.			D. G. M.			D. G. M.			D. G. M.		
1	7	0	1	6	54	1	6	48	1	6	53
2	7	22	2	7	17	2	7	11	2	7	16
3	7	44	3	7	39	3	7	33	3	7	38
4	8	7	4	8	1	4	7	55	4	8	1
5	8	29	5	8	24	5	8	18	5	8	23
6	8	51	6	8	46	6	8	40	6	8	45
7	9	13	7	9	8	7	9	2	7	9	7
8	9	36	8	9	30	8	9	24	8	9	30
9	9	58	9	9	52	9	9	42	9	9	52
10	10	19	10	10	13	10	10	8	10	10	13
11	10	41	11	10	35	11	10	29	11	10	35
12	11	2	12	11	0	12	10	51	12	10	56
13	11	23	13	11	18	13	11	12	13	11	17
14	11	45	14	11	39	14	11	33	14	11	39
15	12	5	15	12	0	15	11	54	15	11	59
16	12	26	16	12	21	16	12	15	16	12	20
17	12	47	17	12	41	17	12	36	17	12	41
18	13	7	18	13	1	18	12	56	18	13	1
19	13	27	19	13	22	19	13	17	19	13	21
20	13	47	20	13	41	20	13	36	20	13	41
21	14	6	21	14	1	21	13	56	21	14	1
22	14	26	22	14	21	22	14	16	22	14	17
23	14	45	23	14	40	23	14	35	23	14	39
24	15	4	24	14	59	24	14	54	24	14	58
25	15	23	25	15	17	25	15	13	25	15	17
26	15	41	26	15	36	26	15	31	26	15	35
27	15	59	27	15	54	27	15	50	27	15	54
28	16	17	28	16	12	28	16	8	28	16	12
29	16	35	29	16	30	29	16	25	29	16	29
30	16	52	30	16	47	30	16	43	30	16	47
31	17	9	31	17	4	31	17	0	31	17	4

South
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November.

First.	Second.	Third.	Fourth.
1	2	3	4
1593	1594	1595	1596
1597	1598	1599	1600
1601	1602	1603	1604
1605	1606	1607	1608
1609	1610	1611	1612
D.G.M.	D.G.M.	D.G.M.	D.G.M.
1 17 26	1 17 21	1 17 17	1 17 36
2 17 42	2 17 38	2 17 33	2 17 53
3 17 58	3 17 54	3 17 49	3 18 9
4 18 14	4 18 9	4 18 6	4 18 25
5 18 29	5 18 25	5 18 22	5 18 41
6 18 44	6 18 40	6 18 37	6 18 55
7 18 59	7 18 55	7 18 52	7 19 10
8 19 14	8 19 10	8 19 6	8 19 24
9 19 26	9 19 24	9 19 21	9 19 38
10 19 42	10 19 36	10 19 35	10 19 52
11 19 45	11 19 52	11 19 48	11 20 5
12 20 8	12 20 5	12 20 7	12 20 18
13 20 21	13 20 18	13 20 14	13 20 30
14 20 34	14 20 30	14 20 27	14 20 43
15 20 46	15 20 42	15 20 39	15 20 54
16 20 57	16 20 54	16 20 51	16 21 6
17 21 8	17 21 5	17 21 3	17 21 17
18 21 19	18 21 16	18 21 14	18 21 27
19 21 29	19 21 27	19 21 24	19 21 37
20 21 30	20 21 37	20 21 35	20 21 47
21 21 49	21 21 47	21 21 44	21 21 56
22 21 58	22 21 56	22 21 54	22 22 5
23 22 7	23 22 5	23 22 3	23 22 14
24 22 15	24 22 21	24 22 11	24 22 21
25 22 23	25 22 14	25 22 19	25 22 29
26 22 31	26 22 29	26 22 27	26 22 36
27 22 38	27 22 37	27 22 34	27 22 43
28 22 44	28 22 43	28 22 41	28 22 49
29 22 50	29 22 49	29 22 47	29 22 55
30 22 56	30 22 54	30 22 53	30 23 0

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December.

First.	Second.	Third.	Fourth.
1	2	3	4
1593	1594	1595	1596
1597	1598	1599	1600
1601	1602	1603	1604
1605	1606	1607	1608
1609	1610	1611	1612
D.G.M.	D.G.M.	D.G.M.	D.G.M.
1 23 1	1 23 0	1 23 58	1 23 5
2 23 6	2 23 5	2 23 4	2 23 10
3 23 10	3 23 9	3 23 8	3 23 41
4 23 14	4 23 13	4 23 12	4 23 17
5 23 17	5 23 17	5 23 16	5 23 10
6 23 20	6 23 20	6 23 9	6 23 22
7 23 23	7 23 22	7 23 22	7 23 25
8 23 25	8 23 25	8 23 24	8 23 26
9 23 26	9 23 26	9 23 26	9 23 27
10 23 27	10 23 27	10 23 27	10 23 28
11 23 28	11 23 28	11 23 28	11 23 18
12 23 28	12 23 28	12 23 28	12 23 18
13 23 28	13 23 28	13 23 28	13 23 18
14 23 27	14 23 27	14 23 27	14 23 26
15 23 26	15 23 26	15 23 26	15 23 24
16 23 24	16 23 24	16 23 25	16 23 21
17 23 21	17 23 22	17 23 23	17 23 18
18 23 19	18 23 20	18 23 20	18 23 15
19 23 16	19 23 17	19 23 17	19 23 12
20 23 12	20 23 13	20 23 14	20 23 8
21 23 8	21 23 7	21 23 10	21 23 6
22 23 3	22 23 4	22 23 5	22 23 57
23 22 58	23 22 59	23 22 1	23 22 52
24 22 52	24 22 54	24 22 56	24 22 46
25 22 47	25 22 48	25 22 50	25 22 40
26 22 40	26 22 42	26 22 43	26 22 33
27 22 36	27 22 35	27 22 37	27 22 25
28 22 30	28 22 28	28 22 30	28 22 18
29 22 22	29 22 20	29 22 22	29 22 9
30 22 14	30 22 12	30 22 14	30 22 0
31 22 6	31 22 4	31 22 6	31 22 52

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The Seaman's Secrets.

What is the Chart?

The Sea Chart is a speciall instrument for the Seaman's vse, whereby the hydrographicall description of the Ocean Seas, with the answerable geographicall limits of the earth, are supposed to be in such sort given as that the longitudes and latitudes of all places, with the true distance and course betwene place and place might thereby be truly knowne. But because there is no proportionable agreement betwene a Globus superficies and a plaine superficies, therefore a Chart doth not expresse that certainty of the premises which is thereby pretended to be given, for things are best described vpon bodies agreeable to their own forme. And whereas in the true nature of the Sphere there can bee no parallels described but the East and West courses onely, the rest of the courses being concurred lines, ascendent toward the Poles, the Peridians al concurring and joining together in the Poles, notwithstanding in the Sea Chart all those courses are described as parallels, without any diuersity, alteration, or distinction to the contrarie, whereby the instrument is apparantly faultie: yet it cannot bee denyed but Charts for short courses are to very good purpose for the Pilots vse, and in long courses be the distance neuer so farre if the Pilot returne by the same course, whereby in the first he prosecuted his voyage, his Chart will be without error, as an instrument of very great commoditie: but if he returne by any other way, then by that which he went forth, the imperfections of the Chart will then appeare to be very great, especially if the voyage be long, or that the same be in the North partes of the worlde, the farther towards the North, the more imperfect: therefore there is no instrument answerable to the Globe or paradorall Chart, for all courses and climats whatsoever, by whom all desired truth is most plentifully manifested, as shall hereafter at large be declared, but for the coasting of any shore or country, or for short voyage, there is no instrument more convenient for the Seaman's vse, then the well described Sea Chart.

What is the vse of the Sea Chart?

By the directions of the sea chart the skillfull pilot conuatieth his ship from place to place, by such courses as by the chart are made known vnto him together with the helpe of his compasse or Crosse staffe as before is shewed, for the Crosse staffe, the Compasse, and the Chart, are so necessarily ioyned together, as that the one may not well be without the other in execution of the premises of Navigation: for as the Chart sheweth the courses, so doth the Compasse direct the same, and the Crosse staffe by every particular observed

The Seaman's Secrets.

Latitude doth confirme the truth of such courses, and also giueth the certayne distance that the ship hath sayled vpon the same.

And in the vse or vnderstanding of the Sea Chart there are fīue thinges cheifly to be regarded.

The first is, that the Countries or geographie of the Chart bee knowne, with every Cape, Promontory, Port, Haven, Bay, Sands, Rocks, and dangers therein contayned.

Secondly, that the lines drawne vpon the Chart, with their seuerall properties be likewise vnderstood.

Thirdly, that the latitudes of such places as are within the Chart be also knowne, as by the Chart they are expressed.

Fourthly, that you bee able to measure the distances betwene place and place vpon the Chart.

And fifthly, the Seaman must be able by his Chart to know the true courses betwene any Isles, continents, or Capes whatsoever, for by these fīue linealities, the Chart is to be vied in the skill of Navigation.

How is the latitude of places knowne by the Chart.

The latitude is thus found by the Chart, vpon the place whose latitude you desire to know, set one foote of your compasses, then stretch the other foote to the next East and West line (for that line is your director) keeping that foote still vpon the same line, moue your hand and Compasses East or West as occasion requireth, vntill you bring the Compasses to the graduated Meridian, and there that foote of the Compasses which stoode vpon the place whose latitude you would know, doth shew the latitude of the same place.

How is the course betwene place and place knowne

When there are two places assigned, the course betwene which you desire to know, set one foote of your Compasses vpon one of the places, then by discretion consider the lines that lead toward the other place, stretching the other foote of the Compasses to one of those lines, and to that part of the line which is nearest to you, keeping that foote still vpon the same line, moue your hand and Compasses toward the other place, and see whether the other foote of the Compasses that stood vpon the first place, do by this direction touch the second place, which if it doe, then that line whereupon you kept the one foote of your Compasses, is the course betwene those places: but if it touch not the place, you must by discretion search vntill you finde a line, whereupon keeping the one foote of the Compasses, will lead the other foote

The Seaman's Secrets.

note directly from the one place to the other, so; that is the course betwene those two places.

How is the distance of places found vpon the Chart.

If the places be not farre asunder, stretch a paire of Compasses betwene them, setting the one foot of the compasses vpon one of the places, and the other vpon the other place, then not altering the compasses, set them vpon the graduated Meridian of your Chart, & allow ing 20. leagues for every degree that is contained betwene the 2. feet of your Compasses, the distance desired is thereby knowne: if betwene the places there be 5. degrees, then they are 100. leagues asunder, &c. But if the distance betwene the places be so great, as that the compasses cannot reach betwene them, then take out 5. degrees with your compasses which is 100. leagues, and therewith you may measure the distance as practise will teach you. There is also in every Chart a scale of leagues laid downe, whereby you may measure distances, as commonly is vsed

How doth the Pilot order these matters, thereby to conduct his ship from place to place.

In the execution of this part of Navigation, both with care, consider three especiall things, & hereupon the full practise

first is, the good obseruation of his latitude which howe it is before sufficiently exprest.

is a carefull regarde vnto his steredge, with very diligent of the truth of his Compasse, that it be without variation or

other impediments.

3 And the third is a careful consideration of the number of leagues that the ship sayleth in every houre or watch, to the nearest estimation that possibly he can giue, for any two of these three practises being truly giuen, the third is thereby likewise knowne.

As by the Course and height the distance is manifested, by the distance and Course the height is known: by the height and distance the Course is giuen, of which 3. things the Pilot hath onely his height in certaintie: the course is somewhat doubtful, and the distance is but barely supposed, notwithstanding from his altitude and Course hee concludeth the truth of his practise, proceeding in this sort.

First he considereth in what latitude the place standeth from whence hee sayleth his course, which so; an example shalbe the A yart standing in 50. de-

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latitude doth confirme the truth of such courses, and also giueth the certayne distance that the ship hath sayled vpon the same.

And in the vse of vnderstanding of the Sea Chart there are fīue thinges cheifly to be regarded.

The first is, that the Countries or geographie of the Chart bee knowne, with euery Cape, Promontory, Port, Hauē, Bay, Sands, Rocks, and dangers therein containned.

Secondly, that the lines drawne vpon the Chart, with their seuerall properties be like wise vnderstood.

Thirdly, that the latitudes of such places as are within the Chart be also knowne, as by the Chart they are expressed.

Fourthly, that you bee able to measure the distances betwene place and place vpon the Chart.

And fifthly, the Seaman must be able by his Chart to know the true courses betwene any Isles, continents, or Capes whatsoever, for by these fīue singularities, the Chart is to be used in the skill of Navigation.

How is the latitude of places knowne by the Chart.

The latitude is thus found by the Chart, vpon the place whose latitude you desire to know, set one foote of your compasses, then stretch the other foote to the next East and West line (for that line is your director) keeping that foote still vpon the same line, moue your hand and Compasses East or West as occasion requireth, untill you bring the Compasses to the graduated Meridian, and there that foote of the Compasses which stood vpon the place whose latitude you would know, doth shew the latitude of the same place.

How is the course betwene place and place knowne

When there are two places assigned, the course betwene which you desire to know, set one foote of your Compasses vpon one of the places, then by discretion consider the lines that lead toward the other place, stretching the other foote of the Compasses to one of those lines, and to that part of the line which is nearest to you, keeping that foote still vpon the same line, moue your hand and Compasses toward the other place, and see whether the other foote of the Compasses that stood vpon the first place, do by this direction touch the second place, which if it doe, then that line whereupon you kept the one foote of your Compasses, is the course betwene those places: but if it touch not the place, you must by discretion search until you finde a line, whereupon keeping the one foote of the Compasses, will lead the other foote

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note directly from the one place to the other, so that is the course betwene those two places.

How is the distance of places found vpon the Chart.

If the places be not farre asunder, stretch a paire of Compasses betwene them, setting the one foot of the compasses vpon one of the places, and the other vpon the other place, then not altering the compasses, set them vpon the graduated Meridian of your Chart, & allowing 20. leagues for every degree that is contained betwene the 2. feet of your Compasses, the distance desired is thereby knowne: if betwene the places there be 5. degrees, then they are 100. leagues asunder, &c. But if the distance betwene the places be so great, as that the compasses cannot reach betwene them, then take out 5. degrees with your compasses which is 100. leagues, and therewith you may measure the distance as practise will teach you. There is also in every Chart a scale of leagues laid downe, whereby you may measure distances, as commonly is used.

How doth the Pilot order these matters, thereby to conduct his ship from place to place.

The Pilote in the execution of this part of Navigation, both with carefull regarde consider three especiall things, & hereupon the full practises are grounded.

1. Of which the first is, the good obseruation of his latitude which howe it may be knowne is before sufficiently exprest.

2. The second is a carefull regarde vnto his Steredge, with very diligent examination of the truth of his Compass, that it be without variation or other impediments.

3. And the third is a careful consideration of the number of leagues that the ship sayleth in every houre or watch, to the nearest estimation that possibly he can giue, for any two of these three practises being truly giuen, the third is thereby likewise knowne.

As by the Course and height the distance is manifested, by the distance and Course the height is known: by the height and distance the Course is giuen, of which 3. things the Pilot hath onely his height in certaintie: the course is somewhat doubtful, and the distance is but barely supposed, notwithstanding from his altitude and Course hee concludeth the truth of his practise, proceeding in this sort.

First he considereth in what latitude the place standeth from whence hee saileth by his course, which for an example shalbe the L. part standing in 50. de-

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degrees of septentrionall latitude, then directing his course so. In saileth 3. or 4. dates or longer in such thick weather, as that he is not able to make any observation of the Poles altitude, in which time he omitteth not to keepe an accompt how many leagues the ship hath sailed upon that course as nere as he can gesse, which number of leagues in this example shalbe 100. according to his iudgement: then hauing conuenient weather, he obserueth in what latitude hee is, and findeth himselfe to be in 47. degrees, now with his compasses hee taketh the distance of 100. leagues, which is the quantitie of the ships run by his supposition, and then setting one foote of the Compasses vpon the Li:art, which is the place from whence he began his course, and directly so. Will. from the same he setteth the other point of the compasses, by the direction of another paire of compasses, in such sort as courses are found and there he maketh a prick for the place of his ships being, according to his reckoning and Course.

And now searching whether it do agree with his height, (for the height course, and distance must all agree together) he findeth that his prick standeth in 46. degrees, 29 minutes, but it should stand in 47. degrees, to agree with his obseruation. Wherefore perceiuing that he hath giuen the ship too much way, he bringeth his course and obserued altitude to agree, and then hee saith that his ship hath sayled but 8. leagues, & there he layeth down a prick for the true place of his ships being, according to his course and latitude, so by his course and height he findeth the truth of his distance, and reprimeth his supposed accompt to be 15. leagues too much: & after this sort he proceedeth from place to place, vntill he arriue vnto his desired porte: which is a conclusion infallible if there be no other impediments, (whereof there hath not been good consideration had) which may breede error, for from such negligence there may arise many inconueniences.

What may those impediments be?

By experience at the Sea we find many impediments that do disturb the expected conclusion of our practises, as that they agree not with the true positions of arte. For first it is a matter not common to haue the winde so beneficial, as that a ship may saile thereby, betwene any two assigned places vpon the direct course, but that by the contrarietie of windes, she may be constrained to traueers vpon all points of the Compass, (the nature whereof I haue before sufficiently expressed.)

Secondly although the winde may in some sort fauour, yet the ship may haue such a leeward condition, as that she may make her way 2. or 3. points from her ceping.

Thirdly the steege may bee so disorderly handled, as that thereby the

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Pylote may be abused.

And lastly, the *copasse* may be so varied, as that the *Pilote* may likewise thereby be drawne into error, at all which things & many moe, as the nature of his sailing, whether before the wind, quartering or by a bowling, or whether with lofty or low sailes, with the benefits or hinderances of the sea, tides, gates, streames, and forced set thereof, &c. Of all which things (I say) the skillfull *Pylote* must haue carefull consideration, which are better learned by practise then taught by penne, for it is not possible that any man can be a good and sufficient *pylot* or skillful *Seaman*, but by painful and diligent practise with the assistance of arte, whereby the famous *pylot* may be esteemed worthy of his profession, as a member meete for the common weale.

And now hauing sufficiently shewed you the ordering of your *Chart* for the execution of the skill of *Navigation*, and being also desirous that you should effectually vnderstand the full nature and vse of the same. I thinke it good by a few questions to giue you an occasion to exercise your selfe in the perfect accomplishment of such conclusions as are by this excellent and commodious instrument to be performed.

Necessary questions for the better vnderstanding of the

commodious vse of the *Chart*.

1. Q. If I saile 70. leagues vpon the Southwest course, I demaund how many degrees I shall lay or depresse the pole?

A. The difference wilbe 2. degrees, 30. minutes.

2. Q. If in sailing West Norwest I raise the pole 3. degrees, 30. minutes, I demaund how many leagues I haue sailed?

A. The distance sailed, is 180. leagues.

3. Q. If in sailing 108. leagues betwene West and Nor I raise the pole 3. degrees, I demaund vpon what course I haue sailed, and how farre I am from the Meridian from whence I began that course?

A. The course sailed is N. w. b. W. and the distance from the Meridian is 90. leagues.

4. Q. If in sailing 154. leagues I be 80. leagues West from the Meridian from whence I began my course, I demaund vpon what point of the *Compass* I haue sailed, and how much I haue rayled the pole?

A. The course is N. W. b. N. and the pole is rayled 6. degrees.

5. Q. If I saile N. w. vntill I be 50. leagues from the Meridian where I began my Course, I demaund how many leagues I haue sailed, & how much the pole is rayled?

A. The distance sailed is 71. leagues, and the pole is rayled 2. degrees, 32. minutes.

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6 Q. If in sayling **N. P. W.** I doe in 30. howers raise 2. degrees, howe many degrees should I haue rayled the Pole, if the same motion had bene South and by West?

A. You should haue raised 5. degrees.

7 Q. A ship sailing towards the West, for euery 80. leagues that she sayleth in her Course, she departeth from the Meridian from whence she began the same Course 45. leagues, I demaund vpon what point of the Compass & how many leagues she hath sayled, in raising the pole 5. degrees?

A. She hath sayled Southwest by South 120. leagues.

8 Q. A pylote sailing toward the west 100. leagues, hath forgotten his Course, yet thus much he knoweth, that if he had sailed vpon such a Course, as that in 160. leagues sayling he would haue rayled the Pole 3. degrees, he should then haue bene twice as farre from the Meridian as now he is, and should also haue bene $\frac{1}{2}$ degree further to the Southward then now he is, I would now know what course he hath sailed, how many leagues, and how farre he is seperated from the Meridian from whence he began the sayde Course.

A. Shee hath sailed 88. leagues Southwest by west, and is 73. leagues from the Meridian nearest.

9 Q. Two ships departing from one place, the one sayling 145. leagues towards the west, hath raised the pole 4. degrees, and the other hath rayled the pole 7. degrees, and is 95. leagues West from the Meridian of the place from whence he began his course, I demaund by what course the said ship hath sailed, how farre they be asunder, and by what course they may meete?

A. The first ship hath sailed Southwest by west, the second hath sayled Southwest by north, 170. leagues, they are asunder 65. leagues, & the course betwene them is South northeast, and South southwest.

10 Q. Two ships sayling from one place, the one in sailing 180. leagues, is to the eastward of the Meridian where he began his course 150. leagues, I demaund vpon what course and how many leagues the other ship shall saile, to bring himselfe 50. leagues **S. b. W.** from the first ship?

A. The first ship hath sailed **S. e. b. e.** and hath rayled the Pole 5. degrees, the second ship must saile northeast by north 237. leagues.

Although

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Although it may seeme (to some that are very expert in Nauigation) that these questions are needlesse, and without vse, beyng so plaine as not deseruing in this sort to be published, notwithstanding that theyr opinion, I do in friendly curtesie aduise all young practisers of this excellent arte of sayling, that they doe not onely by their Charts prooue the truth of these answered questions, but also indeuour themselves to propound diuers other sorts of questions, and in seeking their answeres, to enter into the reason thereof: for by such exercise, the yong beginner shall vnderstand the substantial grounds of his Chart, and grow perfect therein: for whose ease and furtherance onely, I haue at this present published this brieft treatise of Nauigation, knowing that the expert Pylote is not vnfurnished of these principles, but euery little helpe dooth greatly further in euery beginning: and therefore for the further benefite of the practiser, I haue hereunto annexed a particular Sea Chart of our Channell, commonly called the Sleue, by which all that is before spoken as touching the vse of the Chart, may be practised, wherein the depths of the Chanell are truely layde downe: being an instrument most commodious and necessary for all such as seeke the chanell comming out of the ocean Sea, much of it is from my owne practise, the rest from pylotes of very good sufficiencie: I haue founde great certaintie by the vse of this Chart, for by the altitude and depth I haue not at no time missed the true notice of my Shippes being,

which (through Gods mercifull fauour) by my land
falls I haue found alwayes to be without errour, there-
fore haue it not in light regard, for it will giue you great
evidence, and is worthy to be kept as a speciall iewel for
the Seamans vse, be he neuer so expert.

And thus hauing sufficiently expressed all the practi-
ses appertayning to the skill of Horizontal Nauigation,
which kinde of sayling is now of the greatest sort only
practised, I think it good for your better memory brief-
ly to reporte that which before is spoken as touching
this kinde of Nauigation, and with all it will not be a-
misse to shew you after what sorte I haue bene accu-
stomed to keepe my adcomptes in my practises of say-
ling, which you shall finde to be very sure, plaine, and
easie whereby you may at all times examine what is
past, and so reforme the coses layde downe vpon the
Chart, if by chaunce there should any errour be com-
mitted. And so concluding this parte of Nauigation,
will in the next treatise make knowne vnto you the
vse of the Globe, such vses I meane as the Seaman may
practise in his voyages, and that are most necessary for
his knowledge.

A Table



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A Table shewing the order how the Seaman may keepe his accomptes, whereby he may at all times distinctly examine his former practises for in euery 24 howres, which is from noone to noone, he doth not onely lay downe his latitude, with the corse and leagues, but also how the winde hath blowne in the same time.

The first Columbe is the moneths and daies of the same, the second is the obserued altitude, the third is the Horizontal corse or motion of the Ship, the fourth the number of leagues that the Ship hath sayled, the fifth is a space wherein must be noted, by what wind those thinges haue beene performed: and the next great space is to lay downe any breefe discourse for your memory.

Anno. 1593.						The 23. of March, cape S. Augustine in Brasill being 16. leags east from me, I began this accopt.
Monthes and daies of the month.		Latitude.	Corse.	Leages	Winde	
		G. M.				
March.	24	7 30	N.N.E.	25	East.	Compass varied 9. deg. the South point westward. Compass varied 8. deg. the South point westward.
	25	5 44	N.b.E. norly	36	E. b. N.	
	26	4 1	N. b. N.	35	E. b. N.	
	27	2 49	N.	24	E. b. N.	Compass varied 6. deg. 44. min. the South point westward. Observation, the Pole starre above the Horizon.
	28	1 31	N. easterly.	26	E. b. N.	
	29	1 4	N.N.W.	9	N. E.	
Aprill,	31	0 0	N.b.W.	21	E.N.E.	Compass varied 7. deg. the north point eastward.
	4	0 39	N.W.b.N.	15	N. E.	
	7	1 53	N.N.W.	28	N. E.	
	9	3 5	N.W.b. N.	30	N.e.b.e.	
	10	4 5	N.W.b. N.	22	N. e.	
	11	4 45	N.W.	18	N.e.b.N.	
	12	5 16	N.W.	14	N.e.b.N.	
	13	6 11	N.W.b.N.	23	N.e.	
	14	7 16	N.w.b.N.	24	N.e.	

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A brèefe repetition of that which is before spoken.

There are 3. kinds of Navigation, Horizontall, Paradorall, and sailing upon a great Circle, performed by Cozse and trauers.

A Cozse is the paradorall line, which is described by the Ships motion upon any point of Compasse.

A Trauers is the varietie of the Ships motion upon euery alteration of Cozses.

The Compasse is an artificial Horizon, by which Cozses and Trauerles are directed, and containeth 12. points, and euery point containeth $11\frac{1}{2}$. degrees, or 45 minutes, being $\frac{1}{4}$ of an hower.

By such quantitie of time as the Moone seperateth her selfe from the Sunne, by the like rate of time euery tide doth one differ from another.

In euery hower the tide altereth two minutes, in euery floud twelue minutes, and in euery ebbe twelue minutes, and in euery day 48. minutes, because that so is the Moones seperation from the Sunne: for the Moone doth seperate herselfe from the Sunne, in euery day one point and 3. minutes, betwene the change & the full shee is to the Eastwards of the Sun, and then is her seperation, at which time she is before the Sunne in respect of her naturall motion, but in regarde of her violent motion, she is then behinde or abaft the Sunne.

Betwene the full and the change, she is to the Westward of the Sunne applying towards the Sun, and then is her application, at which time shee is behind or abaft the Sunne, in respect of her naturall motion, but in considerations of her violent motion, she is then before the Sunne.

She hath a violent motion, a naturall motion, a slowe swift and meane motion.

In euery 27. dayes and 8. howers she perfourmeth her naturall motion through the Zodiac.

Betwene change & change there is twenty nine daies, twelue houres, fortie foure minutes nearest.

The solar yere consisteth of 12. months, and the lunar yere of 12. Moones.

The Moones age is found by the Epact.

All instruments vled in Navigation, of what shape or forme soeuer they be, are described or demonstrated upon a Circle or some portion of a Circle, and therefore are of the nature of a Circle.

A degree is the 360. parte of a Circle, how bigge or little soeuer the Circle be.

A degree is applied after the 6. severall sortes, to the Equator, to the Meridian, to the Horizon, to the verticall Circle, to measure, to time.

Altitude is the distance, height, or mounting of one thing aboue another.

The Poles altitude is the distance betwene the Pole and the Horizon,

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or that portion of the Meridian which is contained between the Pole and the Horizon.

The altitude of the Sunne above the Horizon, is that portion of the vertical circle, which is contained between the Horizon and the Sunne.

Latitude is that arke of the Meridian which is contained betweene the parallell of any place and the Equator: or that part of the Meridian which is included between the Zenith and the Equinoctiall.

Longitude is that portion of the Equator contained betweene the Meridian of S. Michaels, one the Isles of the Azores, and the Meridian of the place whose longitude is desired: the reason why the accompt of longitude doth begin at this Ile, is, because that there the Compasse hath no variety, for the Meridian of this Ile passeth by the Poles of the world and the poles of the Magnet, being a Meridian proper to both Poles.

The longitude betwene place and place, is the portion of the Equator, which is contained betweene the Meridians of the same places.

Declination is the distance of the Sunne, Moone, & Starres, from the Equinoctiall, or that part of the Meridian which passeth by the Center of any celestiall body, and is contained betweene the same center and the Equinoctiall.

Hydrography is the description of the Ocean Sea, with all Isles, banks, rocks & sands therein contained, whose limits extend to the geographickall borders of the earth, the perfect notice wherof is the chiefeft thing required in a sufficient pylote, in his excellent practise of sayling.

Geography is the description of the earth onely, whereby the terrestriall forme in his due situation is giuen, whose distinction is by mountaines, riuers, vallies, cities, and places of fame, without regarde of Circles, Clymates and Zones.

Cosmography is the description of the heaucns, with all that is contained within the circute therof, but to the purpose of nauigation, we must vnderstand Cosmography to be the vniuersall description of the terrestriall Globe, distinguished by all such circles, by which the distinction of the celestiall Sphere is vnderstode to be giuen, with euery Country, Coast, Sea Harborow, or other place, seated in their due longitude, latitude, Zone, and Clyme.

The Chart is a speciall instrument in Nauigation, pretending the Cosmographickall description of the terrestriall Globe, by all such lines, circles, courses and diuisions as are required to the most exquisite skill of nauigation.

The end of the First Booke.

Article I. Section 1. All legislative Powers herein granted shall be vested in a Congress of the United States, which shall consist of a Senate and House of Representatives.

Section 2. The House of Representatives shall be composed of Members chosen every second Year by the People of the several States, and the Electors in each State shall have the Qualifications requisite for Electors of the most numerous Branch of the State Legislature.

No Person shall be Representative of this United States who shall not, when elected, have seven Years Residence in this United States, and who, when elected, shall not, when elected, have attained to the Age of twenty five Years, and seven Years Residence in this United States.

Section 3. The Senate of the United States shall be composed of two Senators from each State, chosen by the Legislature thereof, for six Years; and each Senator shall have the Qualifications requisite for Senators of the most numerous Branch of the State Legislature.

Section 4. The Senators and Representatives before Congress, and the Members of the several State Legislatures, and all Persons holding Office under any of them, shall be bound by Oath or Affirmation to support this Constitution.

Section 5. The Congress shall have Power to regulate the Commerce with foreign Nations, to regulate Commerce among the several States, and to regulate Commerce with the Indian Tribes.

Section 6. The Congress shall have Power to lay and collect Taxes, Duties, Imposts and Excises, to pay the Debts and to borrow Money, but no Tax or Duty shall be laid on Imports or Exports, except such as may be necessary for executing the Laws of the United States.

Section 7. All Bills for raising Revenue shall originate in the House of Representatives; but the Senate may propose or concur with Amendments as to the Form of such Bills.

Section 8. The Congress shall have Power to make all Laws which shall be necessary and proper for carrying into Execution the foregoing Powers, and all other Powers vested by this Constitution in the Government of the United States.

Section 9. The Congress shall have Power to coin Money, to regulate the Value thereof, and to fix the Standard of Weights and Measures.

Section 10. No State shall enter into any Treaty, Alliance, or Confederation with any foreign Nation, or State, or enter into any Agreement or Compact with any foreign Nation, or State.

Section 11. The President of the United States shall have the Power to grant Reprieves and Pardons for all Crimes and Offenses, except in Cases of Impeachment.

Section 12. The President of the United States shall have the Power to nominate and to appoint, and shall have the Power to grant Reprieves and Pardons for all Crimes and Offenses, except in Cases of Impeachment.

Section 13. The President of the United States shall have the Power to nominate and to appoint, and shall have the Power to grant Reprieves and Pardons for all Crimes and Offenses, except in Cases of Impeachment.

Section 14. The President of the United States shall have the Power to nominate and to appoint, and shall have the Power to grant Reprieves and Pardons for all Crimes and Offenses, except in Cases of Impeachment.



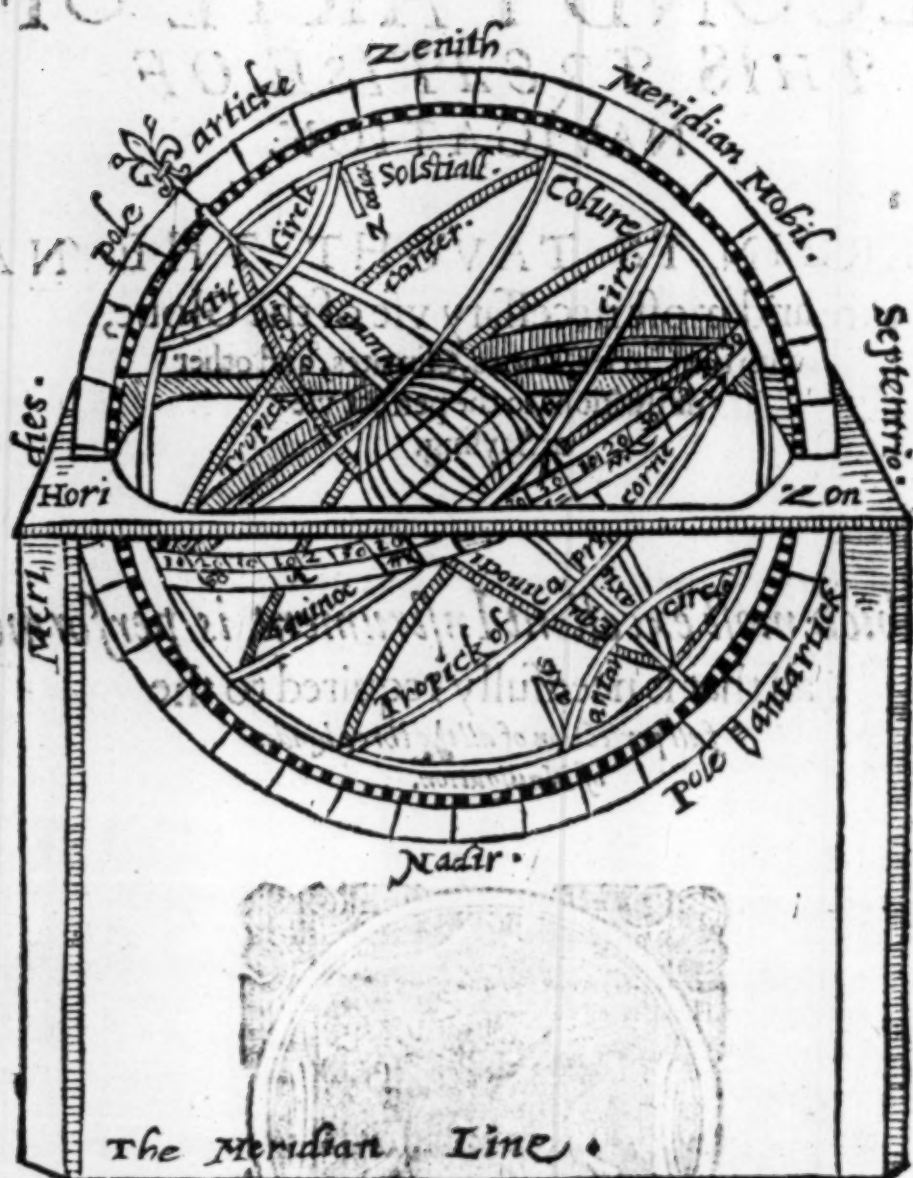
THE
SECOND PARTE OF
THIS TREATISE OF
NAVIGATION.

WHEREIN IS TAUGHT THE NATURE and most necessary vse of the Globe, with the Circles, Zones, Climates, and other distinctions to the perfect vse of Sayling.

*By which most excellent Instrūment is performed
all that is needfully required to the
full perfection of all the three kindes
of Navigation.*



THE SECOND PART OF



The Meridian Line.

THE
SECOND BOOKE OF
THE SEAMANS SECRETS.

What is the Sphere?

The Sphere is a solide body contained vnder one superficies, in the middest whereof there is a point or prick, which is the center of the Sphere, from whence al right lines drawn to the circumference, are equal the one to the other, whereby it is to be understood that the centre of the Sphere is euently placed in his midst, as that it hath like distance from al parts of the Circumference. And forasmuch as the Sphere is an instrument demonstrating vnto vs the vniuersall ingine of the world, we must therefore vnderstand this center to be this terrestrial Globe wherein we haue our being, which compared to the celestiaall Globe or heauely circumference doth beare proportio, as ϕ center to his circle: which earthly globe by the diuine mightie workmanship of God, doth admirably hang vpon his center, being of equal distance from al parts of the circumference.

What are the distinctions of the Sphere?

The Sphere is distinguished by tenne circles, whereof five are great circles, and 4. are lesser circles: whereof there are onely 8. described vpon the body of the Globe, limiting the zones & motion of ϕ Planets, as the Equinoctiall, the Ecliptick, the Equinoctiall Colure, the Solstitiall Colure, the Tropick of Cancer, the Tropick of Capricorne, the Arctick Polar Circle, and the Antartick Polar Circle. The Horizon and Meridian are not described vpon the body of the Globe, but artificially annexed thereunto for the better perfection of his vse.

Which are the great Circles, and which the lesser?

The Equator, the Ecliptick, the 2. Colures, the Meridian and the Horizon are great circles, because they deuide the Sphere into 2. equal parts. The 2. Tropicks, the Polar circles, are lesser circles, because they deuide ϕ Sphere into 2. vnequall partes.

What is the Equator or Equinoctiall?

The Equinoctiall is a great circle deuiding ϕ Sphere into 2. equal parts, leauing the one halfe towards the North, and the other halfe towards the South, and is equally distant from both the Poles of the worlde 90. degrees

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grées, placed euenly betwene them, and described vpon them, this line crosseth the Horizon in the true points of East and West, and hath alwaies his own halfe aboue the Horizon, vnles it be vnder either of the Poles for there the Equator is in the Horizon: it crosseth the Meridian at right Spherick angles, and it also crosseth the Ecliptick line in the first minute of Aries and Libra, deuiding the Ecliptick and Horizon, and is also by them deuided into two equall partes. This line is also deuided into 360. equall partes or degrees, which are the degrees of Longitude, beginning the account in the point of Aries, reckoning towards the East, concluding the number 360. in the place where the first account began: viz. where the Equator both intersecte the Ecliptick in the first minute of Aries, vnder which Meridian S. Michaels one of the pls of the Alfores to be placed in the geographical description of the terrestriall Globe.

What is the vse of the Equator?

The vse of the Equinotiall, is to knowe the declination of the Sunne, Moone and Stars whereby the latitude of places is giuen, for that portion of the Meridian which is contained betwene the Equator and the Center of the Sunne, Moone or Stars, is their declination: also by the Equinotiall is knowne the Longitude of places, for a quarter of a great Circle being drawne from the Pole, in the place whose Longitude is desired, and so continued to the Equinotiall, that degree and minute in which the quarter Circle doeth touch the Equator, is the Longitude of the same place, or if you bring any place (that is described vpon the Globe) whose Longitude you would knowe, vnder the Meridian of the Globe, that degree of the Equinotiall that is then likewise directed vnder the Meridian is the Longitude desired: When the Sunne cometh vpon the Equator, then the daies and nights are of one length through the whole world: and then the Sunne riseth vpon the true point of East, and setteth vpon the true point of West, and not els at any time. This circle being fixed in the firmament, is moued with the first mouer in euery houre 15. degrees, by which account in 24. houers his motion is performed. And here note, that the degrees of the Equinotiall haue a double application, the one to time, and the other to measure: in respect of time 15. degrees make an houre, so that euery degree containeth but 4. minutes of time, but when his degrees haue relation to measure, then euery degree containeth 60. minutes, being 20. leaguess, of that euery minute standeth for a mile after our English account.

But this allowance of 20. leagues to euery degree of the Equinotiall, in sayling, or measuring of distances vpon the East and West Cozles, is onely when you are vnder the same, because the Equinotiall being a parallell, is likewise a great circle, and euery degree of a great circle is truly accounted for 20. leagues, or 60. miles.

But

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But in the rest of the parallels where either of the Poles are elevated above the Horizon, if there you saile or measure vpon Courses of east or West, there are not 20 leagues to be allowed to euery degree, because such parallels are lesser circles, therefore they haue the fewer number of leagues to euery degree: so that the further you depart from the Equator, the lesser are the parallels, and the lesser that any parallell is, the lesser are his degrees, because euery circle containeth 360. degrees, and as the circles and degrees are diminished in their quantitie, in like sorte the distance answerable to such degrees, must abate, as their circles do decrease. And further know, that the Equator, is the beginning of all terrestrial Latitude, and declination of the celestiall bodies.

What is the Ecliptick?

The Ecliptick line is a great circle, deuiding the Sphere into 2. equall partes, by crossing the Equator in oblique sort deuiding him, and being deuided by him into 2. equall parts, bending from the Equator towards the North and South 23. degrees, and 28. minutes, beyng in the first minute of Cancer and Capricorne, there determining the Tropical limits, this line likewise deuideth the Zodiac, by longitude into 2. equal partes, and is deuided together with the Zodiac, into 12. equall portions called signes, and euery of these signes is deuided vpon the Ecliptick into 30. equall partes or degrees, so that this line is deuided into 360. degrees, vpon which line the center of the Sunne doth continually moue: this circle is described vpon his proper poles, named the Pole of the Zodiac, being in all his partes 90. degrees from either of them.

The Zodiac is a circle contrary to all the other, for they are mathematicall lines, consisting only of length, without breadth or thickness: but the Zodiac hath latitude or breadth 12. degrees, whose limits are 6. degrees of either side of the Ecliptick, wherein the Sun, Moone and Planets performe their motions and reuolutions, the center of the Sunne onely keeping vpon the Ecliptick, but the other Planets haue sometime North latitude, and sometime South latitude. And here you must vnderstand, that the latitude of the Planets or Starres, is that portion of the Eclipticall Meridian which is contained betwene center of the Planet or Star and the Ecliptick line, and their longitude is that portion of the line Ecliptick, which is contained betwene the said Meridian and the Eclipticall Meridian that passeth by the poles of the Zodiac and the first minute of Aries.

The 12. deuisions or signes of the Zodiac are these, Aries ♈, Taurus ♉, Gemini ♊, Cancer ♋, Leo ♌, Virgo ♍, Libra ♎, Scorpio ♏, Sagittari ♐, Capricorne ♑, Aquarius ♒, pisces ♓: and these are their characters that stand by them.

The 7. planets that keepe within the limit of the Zodiac are these:

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Mercurie ♿, Jupiter ♃, Mars ♂, Sol ☉, Venus ♀, Mercury ☿, Luna ☾: Saturne performs his course through all the degrees of the Zodiac, once in euery 30. yeeres: Jupiter in 12. yeeres. Mars in 2. yeeres, the Sunne in 365. dayes and 6. houres being one yeere, Venus and ♀ as the Sunne, and the Moone performeth her course in 29. dayes and about 8. houres, through all the degrees of the Zodiac.

And note that this naturall motion of the Planets in the Zodiac, is from the West toward the East, the diurnall motion is violent, caused by the first mouer, or primum mobile, who in euery 24. houres doth performe his circular motion from the East to the West, carrying with him al other inferior bodies whatsoeuer.

What is the vse of the Zodiac?

By the Zodiac and Ecliptick is knowne the Longitude and Latitude of any Celestiall body, either Planets or fixed Starres, for a quarter of a great circle drawne from the pole of the Zodiac to the center of any Planet or Star, and so continued untill it touch the Ecliptick, that degree and minute where the said quarter circle toucheth the Ecliptick, is the longitude of the said body, which is to be accompted from the first minute of Aries, for the longitude of Aries is the portion of the Ecliptick line, which is containned betweene the eclipticall meridian passing by the poles of the Zodiac, and the first minute of Aries, and the eclipticall meridian which passeth by the poles of the Zodiac and the center of any Planet or Starre.

When the Planets are vpon the Northside of the Ecliptick, they haue North latitude, and being South from the Ecliptick, they haue South latitude.

Also the motions of the Planets, the time of any Eclipse, and the Suns declination by his place in the Ecliptick, are knowne by this circle, whose vse is very ample and to great purpose, for all Astronomicall considerations.

What are the Colures?

The Solstitiall Colure is a great circle passing by the Poles of the world, and the poles of the Zodiac, and the Solstitial points or first minute of ♋ and ♏, cutting the Equinoctiall at right Spherick angles, in his 90. and in his 270. degrees.

The Equinoctiall Colure is likewise a great circle passing by the poles of the world, and the equinoctiall point of ♈ and ♎. and crosseth the equator in his first and 18. degrees, and these Colures doe intersect each other in the poles of the world to the right spherick angles.

What is the vse of these Colures?

Their vse is to distinguish the 4. principall seasons of the yeere, Spring, Summer, Autumn, and winter, diuiding the Equator and Ecliptick into 4. equall parts: also that arke of the Solstitiall Colure which is inclu-

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bed betwene the first minute of \mathcal{S} and the Equinoctiall, is the Sunnes greatest declination towarde the North, the like arke being betwene the tropicall point of \mathcal{V} and the Equator, is the Sunnes greatest South declination, being in these our daies 23. degrees, 28. minutes.

What is the Tropick of Cancer?

The Tropick of \mathcal{S} is one of the lesser circles deuiding the sphere into two vnequal parts, and is described vpon the pole Artick, a parallell to the Equator 23. degrees 28. minutes from him, being the farthest limit of the Ecliptick bending towarde the North, to which when the Sunne cometh, the daies are then longest to all those that inhabit in the North partes of the worlde, and shortest to the Southerne inhabitantes: betwene this circle and the Equator are included the 6. septentrionall signes, γ , δ , Π , \mathcal{S} , \mathcal{Q} , \mathcal{W} , in which signes during the time that the Sunne abideth, being from the 11. of March, to the 13. of September, he hath North declination, and then is the spring and Summer to all such as inhabite in the North partes of the worlde, and Autumne and Winter to the inhabitants of the South partes of the worlde: this circle doth touch the Ecliptick in the first minute of \mathcal{S} , where the Sun beginneth his returne towarde the South, wherupon it toke the name Tropick, which signifieth conuersion or returne, by which point of the Ecliptick, the diurnall motion describeth this Circle.

What is the Tropick of Capricorne?

The Tropick of \mathcal{V} , is one of the lesser circles deuiding the sphere into 2. vnequall partes, and is described vpon the pole Antartick, a parallell to the Equinoctiall 23. degrees, 28. minutes from him, being the farthest bending of the Ecliptick towarde the South, to which when the Sunne cometh, the daies are then longest to all those that inhabite in the South partes of the worlde, and shortest to the Northern inhabitantes: betwene this circle and the Equator are included the 6. Southern signes, \equiv , m , f , \mathcal{V} , \mathcal{X} , \mathcal{Z} , in which signes during the time that the Sunne abideth, being from the 13. of September to the 11. of March, he hath South declination, and then is the spring and the Summer to all such as inhabite the South partes of the worlde: and Autumne & Winter to all the inhabitants in the North partes of the worlde: this circle toucheth the Ecliptick in the first minute of \mathcal{V} , by which point the diurnall motion describeth this parallel.

What is the vse of the Tropicks?

By the Tropicks the Suns declination is known, as also the tropickes by the Sunnes farthest motion towarde the North and South, for so much as the Tropicks are distant from the Equator, so much is the sunnes greatest declination: and such as is the Suns greatest declining, such is the distance betwene the Tropicks and the Equator: they are also the limits of the burning zone, seperating the burning & temperat zones, for betwene the

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The two Tropicks, is containned the burning Zone.

What is the Artick polar Circle?

The artick Polar Circle is one of the lesser circles, deuiding the sphere into two vnequall partes, and described vpon the Pole Articke in parallel, to the Tropick of \odot , hauing such distance from the pole as the Tropick hath from the Equato r , being 23. degrees 28. minutes; vpon which circle the Artick pole of the Zodiac is placed, which beynge fixed in the firmament, by the vertue of the first mouer is carried about with the heauens by which motion this circle is described.

What is the Antartick polar circle?

The Antartick polar circle is opposite to the Artick, & parallel to the Tropick of ϖ , being in all respect of such distance and description, from and about the pole Antartick, as the Artick polar circle is about the pole Artick.

What is the vse of the Artick and Antartick polar Circles?

The vse of these 2. polar Circles, is to shew the distance of the poles of the Zodiac, from the poles of the Worlde for so much as the Solsticiall points are distant from the Equato r , so much are the poles of the Zodiac from the poles of the Worlde: the circles doe also deuide and limit the temperate and frozen zones, for betwene the Tropick of \odot , and the Artick polar circle is containned the Northern temperate zone, and betwene the Artick polar circle and the pole Artick, that is within the Artick polar circle is contained the Northern frozen zone. Also betwene the Tropick of ϖ & the Antartick polar circle, is contained the Southern temperate zone, and within the said polar circle is included the Antartick frozen zone, and these are all the circles that are described vpon the body of the Globe.

What is the Meridian?

The Meridian is a great circle passing by the poles of the Worlde, and by your Zenith, deuiding the Horizon into 2. equal parts, in the points North and South, it also deuideth the sphere with all the parallel circles therein contained, into 2. equall partes, crossing them at right spherick angles. And this Meridian is not fixed in the firmament as the rest of the circles are, for if it were, then should it be moued wth the first mouer as the rest are but it is not so: therfore the Meridian is manifested v^{pon} the Globe, by a circle or ring of copper fastened vnto the Globe, vpon the 2. poles, so that the Globe moueth round vpon his 2. poles within the Meridian: this Meridian is graduated in euery of his quarters into 90. degrees, by which his vse is perfourmed: and note that one Meridian may haue many Horizons, yet euery Horizon hath but one Meridian, for if you trauaile South or North, you keepe still vpon the same Meridian, yet in euery sensible difference of distance you shall enter into a change of Horizons, for there be as many

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many Horizons as there be sensible differences of distance, and there be as many Meridians as there be sensible differences of distance, so that the difference be not upon the points North and South, but this copper Meridian annexed to the Globe is to be applyed to all differences and distances whatsoever, as amply as if the number were infinite.

What is the vse of the Meridian :

The vse of the Meridian is to know the highest ascending of the Sun, Moone or Starres from the Horizon, for when they bee vpon the Meridian, then are they farthest from the Horizon, and then is the most convenient time to take the altitude of the Sunne or Starres, thereby to finde the Poles eleuation.

By the Meridian of your Globe is known the latitude and longitude of any place vpon the Globe contained, for if you bring any place vnder the Meridian, the degrees of the Meridian do shew the latitude of the same, and that degree of the Equator which the Meridian doth crosse is the longitude, &c.

What is the Horizon ?

The Horizon is a great circle diuiding the heauens into 2. equall partes the one halfe being aboue the Horizon is alwaies in sight, the other halfe is not seene being vnder the Horizon, and therefore is called the finitoe or limit of our sight, for where the heauens and seas seeme to ioyne together that is the Horizon: the Horizon is not fixed in the firmament, and yet is a fixed circle constant to his proper latitude, but because in the Globe one and the same Horizon may performe whatsoever is required to all eleuations, the Horizon is so artificially annexed to the Globe, that by the motion of the Meridian, in the same there faulteth nothing in his vse: and the Horizons in all respects distinguished, as is the Sea Compasse. There are two kindes of Horizons, a right Horizon, and an oblique Horizon: when the Poles are in the Horizon, then it is a right Horizon, for then the Equator doth cut the Horizon to right angles, making a right Sphere and a right Horizon, an oblique Horizon is where either of the Poles are eleuated aboue the same, for then the Equator doth cut the Horizon to vnlike angles, making an oblique Sphere, and an oblique Horizon. and although the Horizons be diuers and many in number, for euery sensible difference of distance hath his proper Horizon, yet is the Horizon of the Globe so conveniently annexed therunto, as that by the moving of the Meridian in the Horizon, and by the Globes motion in the Meridian, both the Horizon and Meridian are to be applyed as proper to all places whatsoever, and note that the place where you are, is alwayes the center of the plaine superficiall Horizon.

What is the vse of the Horizon.

The Horizon is the beginning of all altitude, for whatsoever is aboue the Horizon, is sayd to haue altitude more or lesse, and by the Horizon such altitudes

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altitudes are giuen with helpe of the crosse staffe, for placing the crosse staffe at your eye, if by the one end of the transuersary you see the Horizon, and by the other end (at the same instant) you see the body obserued, then both the transuersary the w^{ch} upon the staffe the altitude desired, by the horizon the nauigable courses from place to place are likewise known, as also the quantitie of the rising and setting of the Sunne, Moone and Starres: whereby is knowne the length of the daies and nights in all climats and at all seasons: by the Horizon is knowne vpon what degree of Azimuth, the Sun, Moone or Starres are, when they may be seene, in what part of the Heauen soeuer whereby the variation of the Compasse is found, and the Poles altitude may at all seasons be giuen.

Are these all the circles appertaining to the Globe?

There are other Circles which are fixed and doe properly appertaine to euery particular Horizon, as Azimuths, Almicanter, the Artick, and Antartick circles.

What are circles of Azimuth?

Circles of Azimuths, or verticall circles, are quarters of great circles, concurring together in the Zenith, as the meridians do in the pole, and are extended from the Zenith to euery degree of the Horizon, &c. And because they cannot be conveniently described vpon the Globe to bee applied to all horizons, therefore vpon the Meridian of the Globe there is a peece of copper artificially placed, to be removed to any degree of the Meridian at pleasure, which peece of copper representeth the Zenith, and must alway be placed so many degrees from the Equator, as the Pole is eleuated from the horizon: and vnto this zenith there is ioyned a quarter of a great circle called Quarta altitudo, the end whereof both continually touch the horizon, and is so ioyned to the Zenith, as that it may be moued round vpon the horizon, and to euery part thereof at your pleasure: this Quarta altitudo is diuided into 90. degrees, being the distinction of all altitude, and beginneth the atcount from the horizon, which is the beginning of altitude, and concludeth 90. degrees in the Zenith, being the end and extreme limit of all altitude.

What are Almicanter?

Almicanter or circles of altitude, are parallel circles to the horizon, and are described vpon the zenith, as the parallels to the equator, are described vpon the Poles, of which circles there are 90. answerable to the distinctions of the Quarta altitudo, which are the degrees contained betweene the horizon and zenith, these circles cannot be described vpon the Globe, to bee applied to euery horizon, but they are distinguished by the circular motion of the Quarta altitudo, for if I desire to see the Almicanter circle of 10. degrees, by mouing the Quarta altitudo round about the horizon, the Zenith

degree

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degree of their quarter circle, doth shew the Almicanter desired, in what elevation soever.

What is the vse of these two circles?

The quarta altitudo performeth the vse of both, by the quarta altitudo & Horizon the courses frō place to place are knowne according to the true Horizontal position, as hereafter shall plainly appeare: it also sheweth the degree of Azimuth, and obserued altitude of any celestiaall body, in what latitude soever: by the quarta altitudo and Horizon, you may describe a paradorall Compasse vpon the Globe, the Poles height is at all times thereby to be known, and the variation of the Compasse is thereby likewise giuen, as hereafter in the practise you shall be taught.

What are the Artick and Antartick circles?

Every Horizon hath his proper Artick or Antartick circle, those horizons that haue the Pole Artick eleuated aboue them, haue their proper Artick circle, and those that haue the South pole eleuated, haue their proper Antartick circle, the quantitie of which circle is according to the Poles eleuation, for if the Pole be much eleuated, then is the Artick circle great, for the Poles altitude is the semidiameter of this circle, if the pole be in the Zenith, then halfe the heauens is the Artick circle.

What is the vse of this circle?

If the Sunne, Moone, or any Starres be within this circle, they are neuer caried vnder the horizon during the time of their abode therein, wherevpon it commeth to passe that such as trauaile far towards the North, haue the Sunne in continuall viewe, and those that inhabite vnder the pole (if any so doe) the Sunne is in continuall sight for sixe moneths together, because the sixe Septentrionall signes are within the Artick circle, the Equator being in the horizon &c.

There is another small circle which is called Circulus horarius, or the hower circle, to be annexed to the Meridian of the Globe, for the perfection of his vse, this circle must be deuided into 24. equal partes or howers, and those againe into such parts as you please for the better distinction of time: this circle must be fastened to the meridia, so that the howers 12. must stand directly vpon the edge of the Meridian, and the pole must bee the center of this circle, vpon which pole there must be fastened an Index to moue proportionably, as the sphere (vpon any occasion) shalbe moued.

There is also an halfe circle, called the Circle of position, which sith it serueth to no great purpose for Nauigation I here omit, and thus is the Globe fully finished for the perfection of this vse.

What are the Poles of the world?

There are two Poles the North artick Pole, and the South or antartick Pole, which poles are two immouable pickes fixed in the firma-

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ment, whereupon the sphere is moued by vertue of the first mouer, & are the limits of the Aris of the world, as also the extreme terme or band of all declination, being 90. degrees from all partes of the Equator.

By the raising of the Pole from the Horizon is knowne the parallell or latitude of our being, it also giueth the quantitie of the Artick circle, and the obliquitie of the sphere.

What is the Axis of the world?

The Aris of the world is a right line passing by the center of the sphere, and limited in the circumference, about the which the sphere moueth, and is therefore called the Aris of the Sphere, and as all lines comensurable are limited betwene two pointes or prickes, so is the Aris of the world, and those two limiting prickes are called the Poles of the world.

What are the Poles of the Zodiac?

The zodiac hath likewise two Poles, Artick and Antartick, being two prickes fixed in the firmament, limiting the Aris of the zodiac, and are distant from the Poles of the world 23. degrees, 28. minutes, which Poles by the motion of the Sphere doe describe the Poles circles, performing their motion about the Poles of the world in euery 24. houers, by vertue of the first mouer, vpon these poles the Ecliptick & zodiac is described: also a quarter of a great circle graduated into 90. degrees, being fastened to either of these Poles and brought to the center of the Star, the which by that graduation the latitude of the same Starre, and where the quarter circle toucheth the Ecliptick, that is likewise his longitude, also the 7. planets do performe their naturall revolutions vpon these poles, whose motion is from the West towards the East, contrary to the motion of the first mouer.

What is the Axis of the Zodiac?

The Aris of the zodiac, is a right line passing by the center of the sphere, and limited in the circumference, whose limiting pointes are the Poles of the Zodiac, and this Aris is moued by the Sphere as are his Poles.

What are the Poles of the Horizon?

There are two poles of the Horizon, which are the limits of his perpendicular diuision, being equidistant 90. degrees from all partes of the Horizon, and are the extreme limits of all altitude, that pole which is in the upper Hemisphere is called the Zenith, and his opposite Pole is called Nadir, they are extended in the firmament but not fixed in it, for they moue neuer, but remaine alwaies stable to their proper horizon, which could not be if it were fixed in the firmament, for then should they be moued with the firmament as the rest are, by the helpe of these poles is found the Azimuth and Altitude of any celestiall body, for a quarter circle deuised into 90. degrees, and fixed to the Zenith, as is the Quarta almicut, being moued to any

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any celestially body, both by those degrees betwix the almicanter or altitude of the same body from the Horizon, and that parts of the Horizon which the quarter circle reacheth, is the Azimuth of the same body, alwaies provided that the Zenith stand answerable to the poles elevation, that is, so many degrees from the Equator, as the Pole is from the Horizon.



How many Zones be there?

There are 5. zones, 2. temperate zones, 2. frozen zones, and one burning zone, the burning zone lieth betwix the two Tropicks, whose latitude is 46. degrees, 56. minutes, which zone by ancient Geographers is reported to be not habitable, by reason of y^e great heat which there they supposed to be, through the perpendicularitie of the Sunne beames, whose perpetuall motion is within the said zone, but we finde in our travels, contrary to their reporte, that it is not onely habitable, but very populous, containing many famous and mightie nations, and yeeldeth in great plentie the most precious things that by nature's benefit the earth may procreate: twice I haue sayled through this zone, which I found in no sorte to bee offensive,

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but rather comfortable unto nature, the extremitie of whose heat is not furious but tollerable, whose greatest force lasteth but 6. houers, that is, from 9. of the clocke in the morning, vnto 3. in the afternone, the rest of the day and night is most pleasing and delightful: therefore they did nature wrong in their rash repozte.

Of the frozen Zones.

The frozen zones are contained within the polar circle, the Artick frozen zone within the Artick polar circle, & the antartick frozen zone within the Antartick polar circle, which are also reported not to be habitable, by reason of the great extremitie of colde, supposed to be in those parts, because of the Sunnes farre distance from those Zones, but in these our dayes wee find by experience, that the auncient Geographers had not the due consideration of the nature of these zones, for three times I haue bene within the Artick frozen zone, where I haue found the ayre very temperate, yea & many times in calme weather marueilous hot: I haue felt the Sunne beames of as forcible action within the frozen zone in calmes nere vnto the shoze, as I haue at any time found within the burning zone, this zone is also inhabited with people of good stature, shape, and tractable conditions, with whom I haue conuersed and not found them rudely barbarous, as I haue found the Caniballs which are in the straights of Magilane, and Southerne parts of America: In the frozen zone I discovered a coast which I named Desolation at the first being there of, supposing it by the loathsome shape to bee wast and desolate, but when I came to Anchor within the harbours thereof, the people presently came vnto me without feare, offering such poore things as they had to exchange for yron nails and such like: but the Canibals of America slye the presence of men, shewing themselves in nothing to differ from brute beastes: thus by experience it is most manifest that those zones which haue bene esteemed desolate and waste, are habitable, inhabited and fruitful. If any man be perswaded to the contrary of this truth, he shall doe himselfe wrong in hauing so base an imagination of the excellency of Gods creation, as to thinke that God creating the world for mans vse, and the same being deuided but into 5. partes, 2. of those partes should bee to no purpose: but let this saying therefore of the Prophet Elyas be your full satisfaction, to confirme that which by experience I haue truly spoken: For thus sayeth the Lord, *hee created heauen, God himselfe that framed the earth and made it, hee that prepared it, hee created it not in vaine, hee framed it to bee inhabited,* &c. Elyas 45. 18.

Of the temperate Zones.

The temperate Artick zone is included betwene the Tropick of S and the Artick Polar circle, whose latitude or breadth is 42. degrees, 2. minutes

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minutes, within the which we haue our habitation.

The temperate Antartick zone is limited by the tropick of γ and the Antartick Polar circle, and hath breadth of latitude 42. degrees, 2. minutes.



What is a Climate?

A Climate is the space of difference upon the vpper face of the earth, included between two parallels, wherein the day is sensibly lengthened or shortened halfe an hower, so as you traual from the Equator toward the Artick Pole, the Sunne hauing North declination, the dayes do grow longer and longer, vntill at last the Sunne not setting vnder the horizon, you shall haue continuall day, and euery space of distance that altereth the day halfe an hower, is called a Climate: these Climates take their names from such famous places as are within the said Climates, of which there are 9. as by their distinctions may appeare.

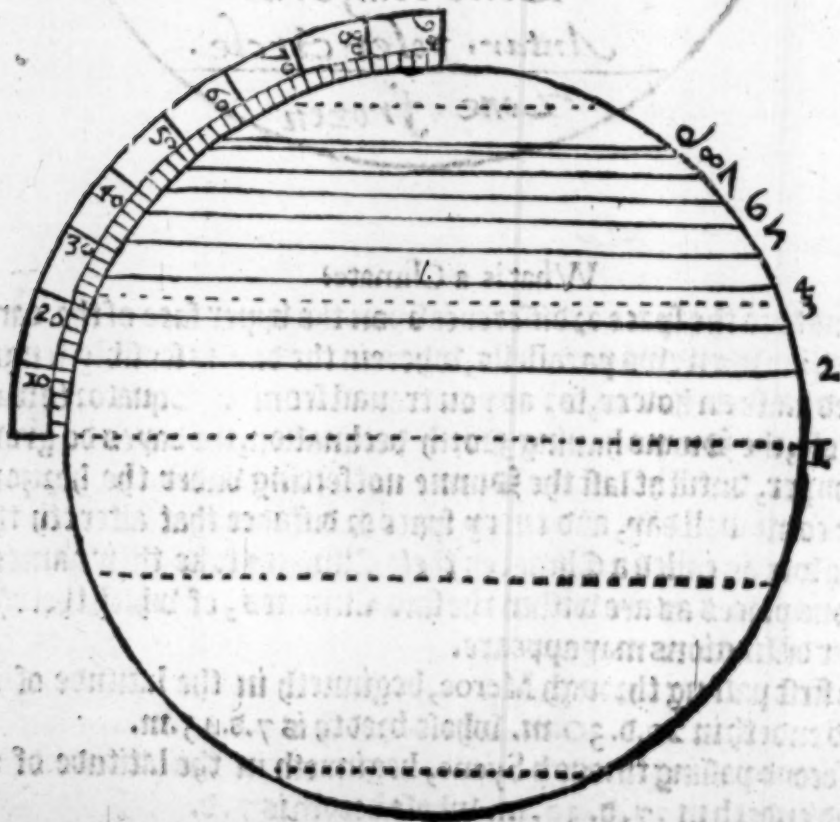
1. The first passing through Meroe, beginneth in the latitude of 12. degrees 45. m. and endeth in 20. d. 30. m. whose breadth is 7. d. 45. m.
- 2 The second passing through Syene, beginneth in the latitude of 20. degrees 30. m. and endeth in 27. d. 30. m. whose breadth is 7. d.
- 4 The third passing through Alexandria, beginneth in the la. of 27. d. 30. m.

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- and endeth in 33.d.40.m. whose breadth is 6.d.10.m.
 4. The fourth passing by Rhodes, beginneth in the la. of 33.d.40.m. and endeth in 39.d. whose breadth is 5.d.20.m.
 5. The fifth passing by Rome, beginneth in the la. of 39.d. and endeth in 43.d.30.m. whose breadth is 3.d.45.m.
 6. The sixt passing by Boristhines, beginneth in 43.d.39.m. and endeth in 47.d.15.m. whose breadth is 3.d.45.m.
 7. The seuenth passing by the Rhipaan mountaines, beginneth in 47.d.15.m. and endeth in 50.d.20.m. whose breadth is 3.d.5.m.
 8. The eight passing by Meotis or London, beginneth in 50.d.20.m. and endeth in 52.d.10.m. whose breadth is 2.d.50.m.
 9. The ninth passing by Denmarke, taketh his beginning in the latitude of 53.d.10.m. and endeth in the latitude of 55.d.30.m. and hath in breadth 2.d.20.m.

If you desire to know how many leagues euery Climate is in breadth, allow for euery degree 20. leagues, or 60. miles, and for euery minut a mile, so is the distance given.

Thus haue I manifested vnto you all the diuisions and particularities of the Spheres distinction.



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What is the use of the Globe?
The use of the Globe is of great ease, certainty, and pleasure, as that the commendations thereof cannot sufficiently be expressed, for of all instruments it is the most rare and excellent, whose conclusions are infallible, giving the true line, angle, and circular motion of any Course or trausers that may in Navigation happen, whereby the longitude and latitude is most precisely knowne, and the certainty of distance very plainly manifested, according to the true nature thereof: it giveth the variation of the Compass, and the hoior or time of the day at all seasons, and in all places, and by the Globe the poles height may at all instantis and upon every point of equinuth of the Horizon by the Sunnes altitude taken be most precisely knowne, by the certainty of whose excellent use, the skilful Pilot shall receive great content in his pleasing practise gubernautick.

How are distances measured vpon the Globe.

When there are 2 places assigned the distance betwene which you desire to know, with a paire of circular compasses you must put it in this sort: set one foot of the compasses vpon one of the places, and the other foot vpon the other place, the Compasses so stretched forth, hang vnto the Equator, and as many degrees as may be contained betwene those two points of the Compass, allowing 60 leagues for every degree is the distance desired: or if the places be of such distance as that you cannot with your Compasses reach them, then take with the Compasses 5. degrees of the Equator, which is 300 leagues, or 10. degrees for 600 leagues, and so measure how often the distance is contained betwene the said places, if a part of a degree both remaine, for halfe a degree allow 30 leagues, for a quarter 15 leagues, &c. but if you desire a most exquisite precisenes in measuring to the minute, second and thirde, then do thus: When your Compasses doth fall vpon any part of a degree, note the distance betwene the end of that degree and the point of the compasses, then with a paire of conuenient compasses take the distance, then measure the same 60. times vpon the equator, (beginning at some certaine place) then consider how many degrees are contained within the measure, and allow every degree to be a minute or mile, so the distance in miles knowne, if any parte of a degree remaine vpon the measure of minutes, do as at the first measuring the same 60. times vpon the equator, the degrees comprehended within the measure, are seconds: if any parcell of a degree remaine vpon these seconds do as in the first, and the degrees contained in this measure are thirds, & so you may proceed infinitely.

How may the Globe be rectified answerable to the true position of the heavens for any place, city, or promontory.

The place being knowne for which you would rectifie the Globe, doe thus bring the place vnder the Meridian, and there consider the latitude

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inde thereof: and as many degrees as that place is from the Equator, so many degrees you must elevate the Pole from the Horizon, then bring the Zenith directly over the same place, and so is your Globe rectified for the execution of any practise: and without this ordering of the Globe, there is no conclusion to be executed by the same.

How is the longitude or latitude of places knowne by the Globe?

By turning the Globe within the Meridian, you must bring the Promontory, Bay, Harbour, Citie, or other place, whose latitude and longitude you seek, precisely under the Meridian, there holding the Globe steady, the degree of the meridian that is directly over the said place, sheweth the latitude thereof, and that degree of the Equinoctiall which is directly under the Meridian is the longitude of the same place.

How is the Course found between place and place?

If two places being assigned, the Course betwixt them which you desire to know, first rectifie the latitude of one of the places, and rectifie the globe answerable unto the same, as before is taught, then bring that place directly under the Meridian and Zenith, if both places be under your Meridian, they then lie South and North, if not, then bring the Quadrant unto the one place, and note upon what part of the Horizon the end thereof shall touch, that is the precise North or South Course betwixt the said places, but this you must consider, that the North or South Course is of the navigable course, unless the places be of small distance, for if any place beare North-east from me, or East from me, or upon any other point, South or South excepted, and be distant 500. leagues, if I saile upon the North or South Course, I shall never arrive unto the same place.

How then shall the Pilote saile by the Globe, if the matter be so doubtful?

The skillfull Pilote that useth this method of navigation, doth first consider the place from whence he shapeth his course, and rectifieth the Globe answerable to the same, then bringing the place directly under the Meridian and Zenith, there holding the Globe steady, bringeth the Quadrant unto the place for which he is bound, the end whereof sheweth upon the Horizon the true North or South Course, upon which Course he sailith 10 or 20 leagues, & there maketh a mark or prick by the edge of his Quadrant, according to the true distance proved by Course, reckoning an altitude as in the use of a Chart: then he bringeth that prick or mark under the Meridian, and there considereth the true latitude of his being, he then rectifieth the globe answerable to the same prick, and keeping the same under the Zenith, doth againe turne the Quadrant unto the place for which he is bound, the end whereof sheweth upon the Horizon the North or South Course, then sailing on at the first

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he maketh a note of pick as before, and thus prosecuting his Course, shall arrive unto his desired place; but in this practise he shall plainly prove that his Horizontall Course will differ greatly, and that by his saying in this sorte, he shall by his notes and picks describe the true navigable and nearest Courses betwene the said places: The like methode is to be observed upon any trauers or forced course whatsoever: and therefore the Pilot must take care, that although the winde be neuer so favourable, yet he must not prosecute any Horizontall Course (North and South onely excepted.)

Therefore I say the Pilot must take speciall care to consider the distance of places, whether the Horizontall Course will lead him betwene the said places: for if places be more then 45. degrees asunder, the Horizontall Course is not the meane to find those places, butesse they lie north and south: for the Horizontall course betwene any 2. places, is a portion of a great circle, which being of large distance, must be performed by great circle navigation, and not by Horizontall Courses: for the collection of many Horizontall Courses being knit together, doe performe a paradoxall motion, altogether differing from a great circle, as for an example: being at Cape verde, there is a place distant from me 80. degrees upon the point Northwest, hither which place I desire to saile, I therefore bring Cape verde under the Meridian of my Globe, there considering the latitude of the Cape, I raise the pole answerable to the same, and place the Zenith directly ouer the Cape, then turning the quarta altitudo to the point Northwest upon the Horizon, all such places as the sayde quarta altitudo then toucheth, doe beare due Northwest from me: now prosecuting this Course by the direction of my Compass, the first day I saile 20. leagues, therefore I make a marke by the edge of the quarta altitudo, 20. leagues from the Zenith, then bringing that marke under the Meridian, I rectifie the Globe answerable to the latitude thereof, the next day I saile other 20. leagues upon the same point, & make a marke as at the first, I bring that marke likewise under the Meridian, and rectifie the Globe as before, and by this methode prosecuting the Course, I shall describe a paradoxall line, which will leade me to the South of the place unto which I would saile, the farther the distance, the greater the difference: by this order you may describe paradoxall lines, upon all the points of the Compass, but this is to be regarded, that your differences be as small as you may, & that none of them exceed 20. leagues, for by the smallest distinctions, is performed the greatest certaintie. And by the description of these lines, you may very manifestly understand the difference of Horizontall paradoxall and great circle navigation. And this may suffice for the sayling use of the Globe, convenient for the Seaman's purpose.

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What is the great Circle navigation?

Great Circle navigation is the chiefest of all the 3 kindes of sayling, in which all the other are contained, and by them this kinde of sayling is performed, continuing a Course by the shortest distance betwene places, not limited to any one Course, either horizonall or paradiorall, but by it those courses are ordered to the full perfection of this rare practise, whose benefites in long voiajes are to great purpose, ordering & disposing all horizonall traueses to a perfect conclusion: for there are many changes of horizonall and paradiorall Courses in the execution of this practise, so that upon the shifting of a wind, when that it may seme that you are forced to an inconuenient Course by the fall of great Circle sayling, that Course shall be found the shortest & an orderly proper motion to performe your voiage. And also when with fauourable winds the Pilot shall shape a Course by his Chart or Compasse paradiorall, as the best meane to attaine his porte, he shall by this kinde of sayling finde a better and shorter Course, and by sufficient demonstration proue the same, so that without this knowledge I see not how Courses may be run, vnder the best advantage: therefore sit by it the perfection of sayling is largely vnderstood, & the errors likewise most substanti- ally corrected, so may of right vnderstande the chiefest place among the practises Substanti- ally. The particularities therof if I should by an orderly method labour to expresse, it would be a discourse ouer large for this place, and as I thinke troublesome if the premises be not well vnderstood: therefore I will not ouerpaasse it, until a time more convenient and of better season.

Of paradiorall Navigation, demonstrateth the true motion of the Ship by a straight Course, as in his true nature by longitude, latitude and distance, finding the full limit or determination of the same, by which motion lines are determined whether circular, no, straight, but conuered or winding lines, and are therefore called paradiorall, because it is beyond opinion that any line should be determined by plane horizonall motion: for the full perfection of which practise I purpose (if God permit) to publish a paradiorall Chart, with all convenient speed, and so will discouer by the same at large, all the practises of paradiorall and great circle navigation, say upon the paradiorall Chart, it will be true the Seaman's purpose being an inuolunt portuall, of safe voiage and small perill, performing the premises of Navigation as largely and as beneficially as the Circle shall respect; And in these practises of sayling before mentioned, may in a generall sense be aptly called Navigation Geometricall, because it consisteth of Geometricall demonstratiue conclusions.

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But there is another knowledge of Navigation, which so farre excelleth all that is before spoken, or that hath hitherto bene vulgarly practised, as the substance his shadow, or as the light surpasseth the thick obscured darkness: and this sweete skill of sayling may well be called Navigation arithmetically, because it wholly consisteth of Calculations, comprehended within the limit of numbers, distinguishing Courses not onely upon the points of the Compass, but upon every degree of the Horizon, and giueth the distance of any trauiers for the particular eleuation of minutes, yea, and lesse partes as, sure your selfe: it giueth longitudes and latitudes to the minute second and third: in so great certaintie, as that by no other meanes the like can be performed: it teacheth the nature of Angles and Triangles, as well Spherical as plaine superficial and solide Commensurations, the effect of lynes straight, circular, and parabolall, the quantities and proportions of parallels, the nature of Horizons, with every particular distinction of any alteration whatsoeuer, that may in Navigation be required to a most wonderfull precise certaintie: so there can nothing be required, that by this heavenly harmonie of numbers shall not be most copiously manifested to the Seamans admiration and great content: the orderly practise whereof to the best of my poore capacitie I purpose to make knowne, if I may receiue my paines already taken, to be receiued in good parte, which I distrust not but all honest minded Seamen, and Pilots of reputation will gratefully embrace, onely in regarde of my friendly good will towards them, for it is not in respect of my paines, but of my loue, that I would receiue fauourable censure.

How may the Poles height be knowne by the Globe?

There are diuers waies to find the poles height by the Globe, as well from the Meridian as upon the same, but sith before I haue sufficiently taught how by the Sunnes Meridian altitude, the poles height may be found, I will therefore in this place speake no further thereof, but for the other kinds it may be knowne as followeth.

How by the Sunes rising or setting, the Poles height may be knowne.

By your Compass of variation, or some magneticall instrument obserue at the same rising, upon what degree of the horizon the center toucheth, according to the true horizontall position of the Magnet, all variation duly considered, that being knowne, search in the tables of the Ephemerides, for the Sunnes place in the Ecliptick, at the time of your obseruation, then bring that place or degree of the Ecliptick wherein you finde the Sunne to be to the Horizon, and moue the Meridian of the Globe as occasion requireth vntill that obscured degree of the Horizon and the Sunnes place in the Ecliptick doe iustly touch together, (for then is the pole in his due Eleua-

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tion, as by the intersection of the Horizon and Meridian may appear, in like sort you may find the Poles altitude, by any knowne fixed Starre in the Horizon.

To finde the poles height by the Sunne, vpon any point
of the Compasse.

By the Compasse of variation, rectified to the true horizontall position, observe the Sunne vntill he come to any point thereof at your pleasure, and in the same instant take the Suns height from the Horizon, then bring the quarta altitudo to that point of the Compasse vpon the Horizon of the Globe where you obserued the Sunne to be, there holding the quarta altitudo steady, moue the Globe vntill you bring the degree of the Ecliptick (wherein the Sunne is at the time of your obseruation) vnto the edge of the quarta altitudo, if it fall vpon that degree of altitude as was the Sunnes obserued height, then doth the Pole stand to his true Elevation, but if it agree not, you must eleuate or depresse the Pole as occasion requireth, rectifying the Zenith answerable thereunto. And againe make it all as at the first, bringing the place of the Sunne to the Quarta altitudo, and setting the same vpon the obserued point of the Compasse, vntill it agree in all respects with your obseruation, and then the Meridian the worth in his intersection with the Horizon, the elevation of the Pole from the Horizon.

To find the Poles height by any giuen Azimuth by the Sun
being aboute the Horizon.

By your magnetical instrument, or compasse of variation observe the Azimuth of the Sun at any time in the forenoone, or afternoone, the nearer the Sun is to the Horizon, the better shalbe your obseruation, and at the same instant take the height of the sun from the Horizon, keep these 2 numbers in memory, & note that the azimuth be obserued according to the true position of the Horizon, by hauing good regard to the variation of the compasse, then bring the quarta altitudo to the place of the Sun in the Ecliptick, and set that degree of the Sunnes place in the Ecliptick vpon the obserued degree of altitude by the graduation of the Quarta altitudo, and if the ends thereof at the same instant do fall right vpon the obserued degree of Azimuth, then is the Pole in his due Elevation: if not, then raise or lay the pole as occasion requireth, alwaies regarding that you place the Zenith answerable to the Poles altitude, and then againe bring the Sunnes place to his altitude vpon the Quarta altitudo, and looke againe whether the ends thereof do touch the obserued degree of Azimuth vpon the Horizon, if not, you must prosecute this order, vntill at one instant the place of the Sunne be vpon his true almicanter, by the edge of the Quarta altitudo, & that the end of the quarta altitudo doe also touch the obserued degree of Azimuth vpon

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upon the Horizon, for then is the Pole in his true elevation, as by the Meridian and Horizon will appeare.

To find the Poles height by the Sunne by any two giuen Azimuths and altitudes, not regarding the true horizontall position or needles variations.

Because there may great errors be committed in the former obseruations vntlesse the Compasse be perfectly well rectified, so as it may respect the true partes or distinctions of the Horizon, it is not amisse to enforme you how without regard of variation, the Poles height may be found.

Therefore by your Magneticall instrument or Compasse of variation obserue the Sunnes azimuth, without regarde of the true horizontall position, and at the same instant obserue also his altitude from the Horizon, keepe those two numbers in memory, then after the Sun hath moued a point or two points of the compasse more or lesse at your discretiō, obserue again his Azimuth and altitude as at the first, then consider the arke of the Horizon through which the Sunne hath moued between these two obseruations, for by the 2. obseruations of the Sunnes altitude, and by the degrees of Azimuth through which the Sunne hath moued, the Poles height is thus knowne: first set the Globe to the elevation of the place wherein you are as nere as you can gesse, & bring the Zenith to the like latitude from the Equator, as the poles elevation is from the Horizon, then bring the quarta altitudo to the place of the Sunne vpon the Ecliptick, for the time of your obseruation, there place the Sunne vpon the first obserued altitude by the degrees of the quarta altitudo, and note the degree of the Horizon which the quarta altitudo then toucheth: this done, bring the Sunnes place to the second obserued altitude, by moving the quarta altitudo and the Globe vntill the degree of the Sunnes place in the Ecliptick and the degree of his altitude vpon the quarta altitudo doe meete. Then againe consider the degree of the Horizon which the end of the quarta altitudo toucheth, and note the arke of the Horizon contained betweene your 2. obseruations, of howe many degrees it consisteth, if it agree with the obseruations made by your Magneticall instrument, then doth the Pole stand in his true altitude, if not you must either raise or depresse the Pole, and againe prosecute the former practise, vntill you find such azimuths and altitudes vpon the Globe, as you found by your Magneticall obseruations, for then the Pole doth stand in his true altitude, and then doth also appeare the true Azimuth of both your obseruations, which if it agree not with your compasse, then is your compasse varied, and may hereby be corrected, so that this doth not onely giue the Poles height, but also the true horizontall position without error.

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To find the Poles height by taking the Suns altitude about the Horizon:
so that the precise time of any such obseruation
be kowne.

If you desire at any time of the day to know the Poles height, as at 8.9.
10. of the clocke, &c. marke diligently the time of your obseruation, at
what instant you doe obserue the Sunnes altitude from the Horizon, the
time and altitude thus known, bring that place of the Eliptick wherein the
Sunne is at the time of your obseruation directly vnder the Meridian, there
holding the Globe stedie, bring the Index of the circulus horarius to the
hower of 12. or none, then moue the Globe vntill the Index come to the
hower of your obseruation, there hold the Globe stedie, then bring the quar-
ta altitudo to the place of the Sunne in the Eliptick, if it agree with your
obserued altitude, then both the pole stand in his true elevation, if not, moue
the Meridian by raising or depressing the pole as occasion requireth, vntil you
bring the altitude and the hower to agree, & then you haue the poles height,
& by the end of the quarta altitudo both also appeare the degree of azimuth,
whereupon the Sun was at the time of your obseruation, and note that in
raising or depressing the pole of the Globe, you must also place the Zenith so
farre from the Equinoctiall, as the pole is from the Horizon, for this is a
generall rule, that so much as the pole is elevated from the Horizon, so much
is the latitude of the Zenith from the Equator, therefore you must alwaies
bring the Zenith and altitude to agree, whensoever you alter the Elevation
be it neuer so little.

To find the Poles height by any two obseruations of the Sunnes altitude,
not regarding the hower of the day, or any horizonall position,
of the Magnet, so that you know the distance of time
betweene the said obseruations.

Although there be some difficultie in giuing the true time of any obser-
uations at the Sea, by reason of the alteration of Horizons, and of the
needles variation, yet it is a matter most easie by a good hower Glasse,
halfe hower Glasse, and minute Glasse, to measure the distance of time be-
tweene any two obserued altitudes, you may therefore vpon that ground
find the poles height with great facilitie at any time, by the Sunne or any
fixed Starre, in this sorte.

Consider in what place of the Eliptick the Sunne is at the time of your
obseruation, bring that place to the Meridian, there with a blacke leade by
mouing the Globe describe a parallell to the Equator, answerable to the
Sunnes diurnall motion and declination for the same instant, then if be-
tweene your obseruations there be an hower, two howers, more or lesse at
your pleasure, as by your running glasse may be knowne, you must allowe
for every hower 15. de. of the Equator, so so much ascendeth every hower,
and

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and for every 4. minutes one degree, and for every minute $\frac{1}{4}$ of a degree, then knowing by this order how many degrees the Sunne is moved betwene your 2. observations, you must upon the parallell which you drawe make 2 notes, so many degrees asunder as the Sunne hath moved, betwene your observations, which may be done in this sorte: bring the place wherein the Sun is vnder the Meridian, and marke what degree of the Equator is then vnder the Meridian, the Globe so standing vpon your parallell close by the Meridian, make the first note or marke, then turne the Globe, and reckon $\frac{1}{2}$ degrees of the Equator that passe vnder the Meridian, vntill so many be past as was your observation, there againe holde the Globe stedy and open your parallell close by the Meridian, make your second note or marke, then knowing the Sunnes altitude at both the observations, you must bring the Quarta altitudo to the first note made vpon your parallel, there holding the globe stedy, the Quarta altitudo and marke agreeing in altitude, bring the Quarta altitudo to the second note, if that do also agree with your former obserued altitude, then both the Globe stand in his true Eleuation, if not, you must eleuate or depresse the Pole by discretion, vntill you bring the 2. obserued altitudes of the Sunne to agree with the two markes which you made vpon your described parallell, and then is the Pole at his true eleuation: and what is spoken of the Sunne, the like may be done by any knowne fixed Starre. I hold this conclusion to be very necessary, pleasant, and easie for the Seamans purpose.

To finde the true place of the Sunne in the Ecliptick
at all times.

BEcause it is most necessarily required in the former practises, that the Sunnes true place in the Ecliptick be at all times knowne, I thinke it not amisse to enforme you how the same may be done.

The cheifest and most certaine meane to know the same, is by the tables of the Ephemerides, but those tables wanting, the Seaman may in this sort doe it: by the Regiment seeke out the declination of the Sunne, that being knowne, bring the Zenith vpon the Meridian, so many degrees and minutes from the Equator as is the Sunnes declination, then moue the globe vntill some degree of the Ecliptick doe come directly vnder the point of the Zenith, for that is the Sunnes place: you must further consider, whether it be betwene March and June, for then you must finde the degree in that quarter of the Ecliptick, contained betwene γ , and \mathfrak{z} : if it bee betwene June and September, you must finde the degree in that quarter of the ecliptick contained betwene \mathfrak{z} , and α , &c. of the rest.

It may also be knowne vpon the Horizon of the Globe, by a Calender Circle that is there described, in this sort: first search the day of your moneth wherein you desire to know the Sunnes declination, and directly a-

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gainst the same degree which standeth for that day; doth also stand the degree of the Zodiac wherein the Sun is at the same time, in a circle representing the Zodiac, and described upon the Horizon.

But if it be Leape yere, you must not take the precise day of the moneth wherein you seeke the Suns place, but the next day following, and against that day seeke the declination.

To finde the Poles height by any two knowne fixed starres.

When you see any 2. fixed Starres which you know to bee both at one instant in the Horizon, vpon your Globe searche for those Starres, and bring one of them to touch the Horizon of the Globe, if the other doe not likewise touch the Horizon, you must raise or depresse the Pole by discrete moving of the Meridian, vntill you bring both those Starres to be at one instant in the Horizon, for then the Globe doth stand to his true elevation.

To finde the Poles height by any two knowne fixed Stars another way.

When you see any fixed Starre that you know to be in the Horizon: you must presently take the height of some other Starre, that you likewise know, before the first be risen from the horizon, then vpon your Globe search for the Star that you obserued in the horizon, bring that star to the horizon of the globe, there holding the globe steady, bring the quarta altitudo to the other Starre whose altitude you obserued, if it agree vpon the quarta altitudo with the obserued altitude, then the Globe doth stand to his true elevation, if not, you must by discretion raise or lay the Pole vntill you find the one Starre in the Horizon, and the other vpon his true obserued altitude, for then the Pole doth stand to his true elevation.

To finde the Poles height at any time by any 2. knowne fixed Starres.

With your crosse staffe take the distance of any two stars from your Zenith, which must be done with as much expedition as may bee, their distances so known, with a paire of compasses, measure so many degrees vpon the Equator, as is the distance of the first obserued Starre, with an other paire of compasses doe the like for the second obserued Starre, vpon the first Starre set one point of the compasses that took his distance, and vpon the second Star set likewise one scote of the compasses that took his distance bring the other two feet of the compasses to meete together, there make a marke, for that is the parallell wherein you be, and that mark is the Zenith, bring it to the Meridian by moving the Globe, and there will appeare the latitude desired, for so many degrees and minutes as that marke is from the Equator, so much is the Pole elevated above the Horizon. This conclusion the Seaman ought to haue in good esteeme.

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To know the precise hower at all times by the Sunne.

For the finding of the hower of the day by the Globe, it is necessary that the Poles height be first knowne, therefore set the Pole to his true elevation, and the Zenith to his answerable latitude, then bring the place of the Sunne in the Ecliptick vnder the Meridian, there holding the Globe stedy, placethe Index of the Circulus horarius vpon 12. of the clock or none, your Globe thus ordered, then with your Crosse staffe take the Sunnes height from the Horizon, that being knowne, you must bring the place of the Sun to the quarta altitudo, by mouing the Globe and quarta altitudo vntill the place of the Sunne doe agree with the obserued altitude, there holding the Globe that hee moue not, the Index doth shew vpon the circulus horarius, the true hower desired.

To finde the hower of the night by any knowne fixed Starre.

Set the Globe to his true altitude, and the Zenith to his answerable latitude, you must also place the Index of the circulus horarius vpon the houre of 12. or none, by bringing the Sunnes place vnder the Meridian, &c. as before you did by the Sunne, then take the height of any knowne fixed Starre, bring that Starre to the quarta altitudo, by mouing the Globe and quarta altitudo vntill the Starre come to his true obserued altitude, there holding the Globe stedy, the Index doth shew vpon the circulus horarius the true time of your obseruation.

To know the length of the daies and nights, at all times, and in all places.

The place and time being giuen wherein you desire to know the length of the day or night, first set the Globe to his altitude for the place, then search the place of the Sunne in the Ecliptik, for the time wherein you take the daies length, bring that place of the Sunne vnder the Meridian, there holding the Globe that he moue not, place the index of the circulus horarius vpon the hower of 12. or none, then turne the Globe vntill you bring the place of the Sun to touch the East part of the horizon, there holding the Globe, you shall see by the Index of the circulus horarius the true time of the Sunnes rising, then bring the place of the Sunne to the West parte of the Horizon, and you shall there see the true time of the Sunnes setting, whereby the length of the day and night doth most plainly appeare. And this may suffice for the vse of the Globe, necessary for the Seamans purpose.

I might here recite the triple rising and setting of the Starres, Cosmice, Acronyce, and Heliace, the ascentions right and oblique, the dawning and twylight, howers equall and vnequall ordinary and planetary, daies naturall and artificiall the triple rising of the Sunne Equinoctiall and Solstitiall, Circles of position with their vse and nature, the horoscope and domifying distinctions of the heauens, the planets, their motions, retrogradations and exconetricitie of their orbs, horologie, and many other most pleasant conclusions:

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clusions : but because they doe in no sort appertaine to the Seamans vse, I therefore omit them, as matters more troublesome then profitable for him, expecting from some learned Mathematician a worke of worthy esteeme, wherein these and many other excellent conclusions shall by cunning demonstration be made knowne vnto vs.

Of the Crosse staffe and his demonstration.

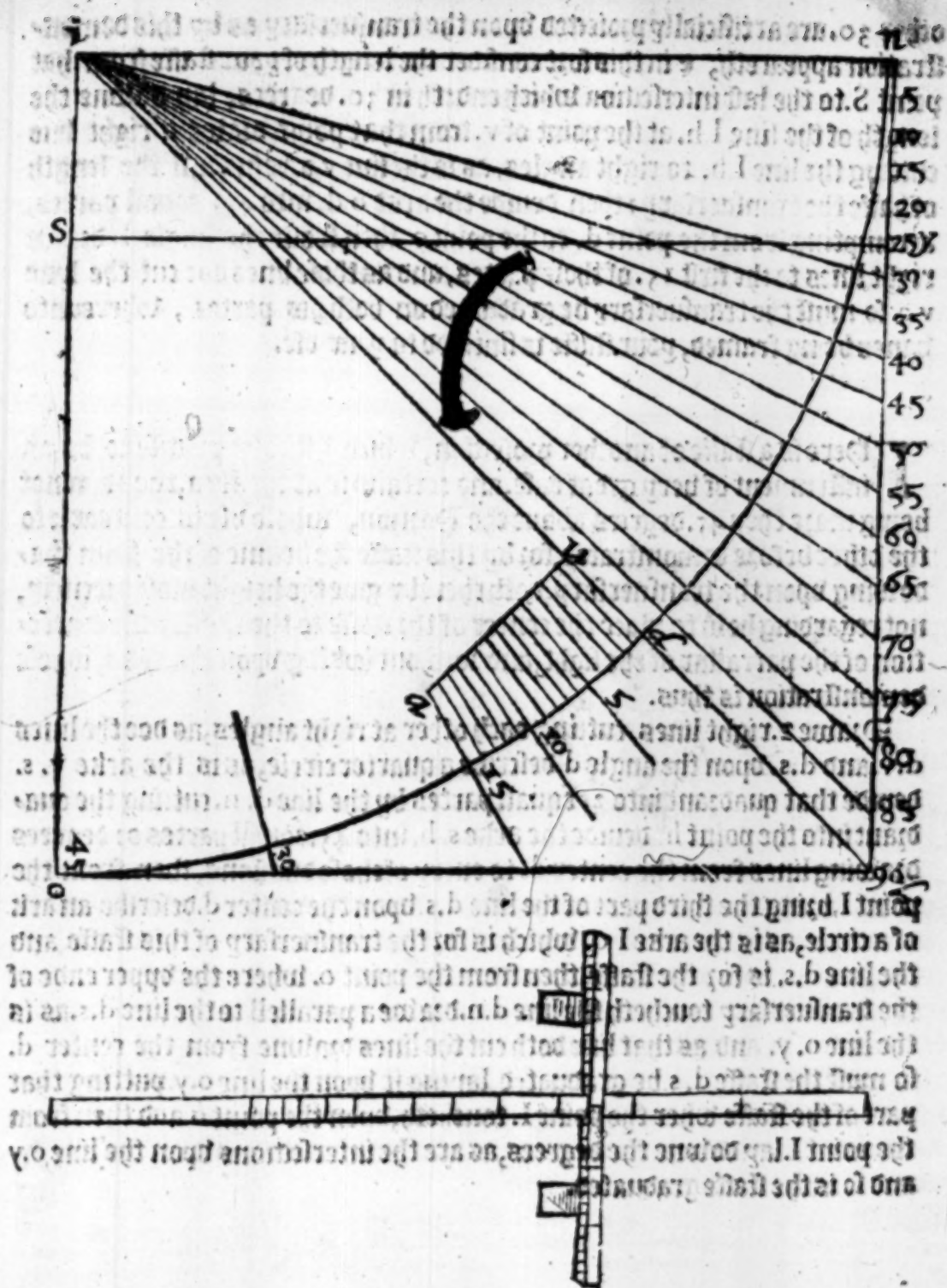
The Crosse staffe is an artificiall quadrant, geometrically projected into that forme as an instrument of greatest ease and exactest vse in Navigation, by which in any naturall disturbance of wether (the Sun or Stars appearing) the Poles height may be knowne, when the Astrolabie or quadrant are not to be vsed. Conueying the vse of the quadrant from the beame of the Sunne to the beame of the eye, for whereas by the quadrant the sun beame perceiuing the Dioptra the weth his height, so by the crosse staffe the beame of the eye conueyed to the Sunne or Starre, doth likewise giue their height. The demonstration whereof is thus.

Make a plaine square consisting of 4. right angles, as is the square, I. o. h. n. the angle I. shalbe assigned the Center of the quadrant, where placing one foote of your Compasses, stretch the other foote to the angle n. and therewith describe a quarter of a circle, as is the arke o. d. n. then from the center I. to his oppositie angle h. drawe a right line, by which line the quadrant o. d. n. is deuided into 2. equall partes, in the point d. deuide the arke d. n. into 90. equall partes, drawing from the center I. lines through e. uery of those diuisions touching in the line n. h. as by this figure appeareth : then consider the length of your transversary, and take halfe thereof laying it vpon the line I. o. in the point S. from that point S. drawe a parallell to the line I. n. as is the line S. y. and as that line doth intersect the diuisions of the halfe quadrant, so shalbe the degrees of the crosse staffe, and note that the sides of the square, must be as long as the staffe that is graduated.

Because



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Because the staffe should be of unreasonable length to contain more then 60. degrees, therefore to keepe him in due forme for the ease of his use, and that the complement of 90. degrees should be contained vpon the staffe, the

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other 30. are artificially projected vpon the transuersary as by this demonstration appeareth, & in this sort consider the length of your staffe from that point S. to the last intersection which endeth in 30. degrees, lay downe the length of the line I. h. at the point of v. from that point drawe a right line cutting the line I. h. to right angles, as is the line v. a. being iust the length of halfe the transuersary: then deuide the arke o. d. into 45. equall partes, accompting from the point d. to the point o. then from the angle I. drawe right lines to the first 15. of thole partes, and as those lines doe cut the lyne v. a. so must the transuersary be graduated on both his partes, whereunto vanes being framed, your staffe is finished to your vse.

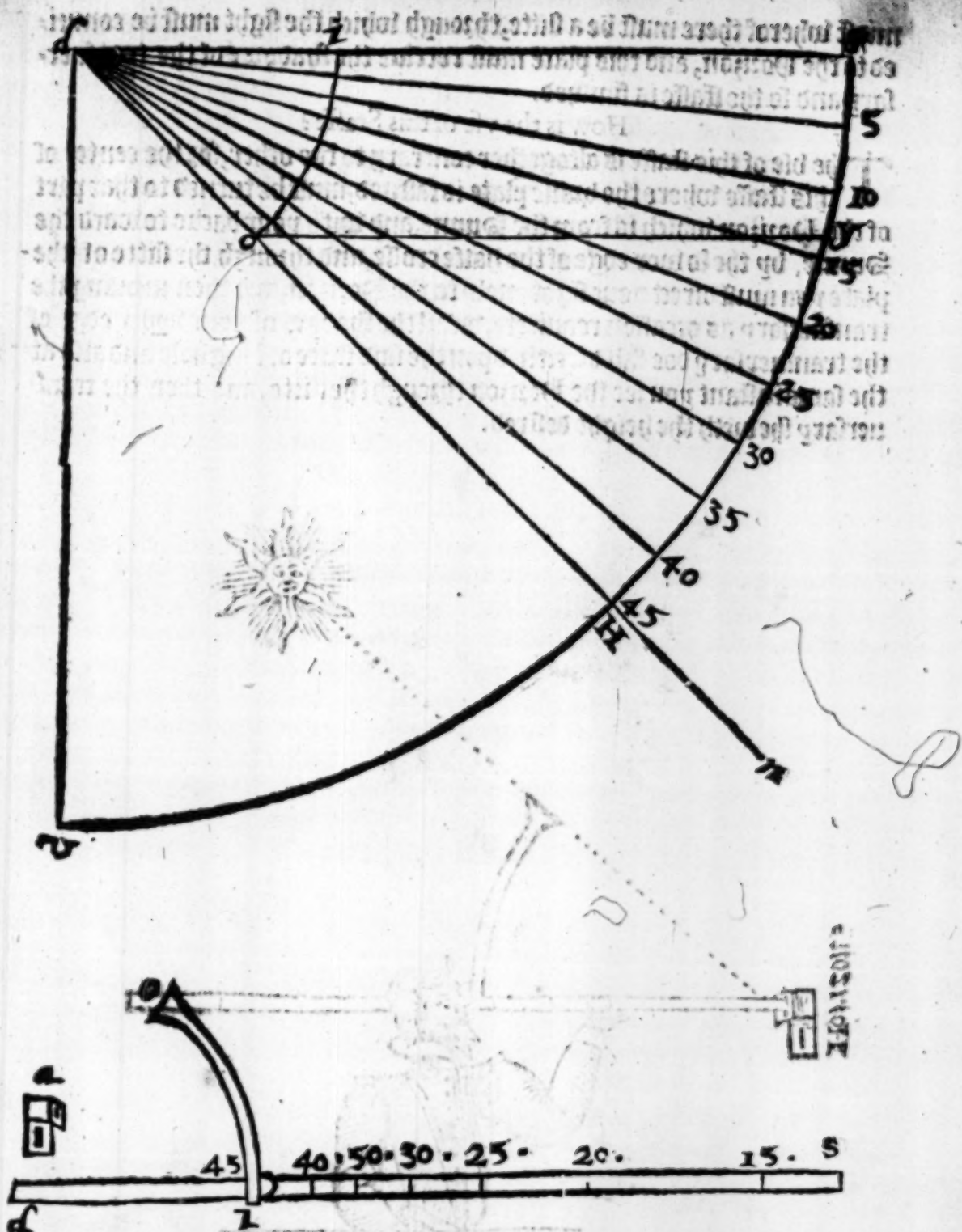
THere is a staffe of another projection, which I find by practise to be an instrument of very great ease, and certaintie at the Sea, the Sun not being more then 45. degrees above the Horizon, whose vse is contrarie to the other before demonstrated, for by this staffe the beame of the Sun shadewing vpon the transuersary, both thereby giue the height most precisely, not regarding how to place the center of the staffe to the eye, for the correction of the parallax of the sight, and without looking vpon the Sun, whose demonstration is thus.

Drawe 2. right lines, cutting each other at right angles, as doe the lines d. v. and d. s. vpon the angle d. describe a quarter circle, as is the arke y. s. deuide that quadrant into 2. equall partes by the line d. n. cutting the quadrant into the point h. deuide the arke s. h. into 45. equall partes or degrees drawing lines from the center d. to euery of those diuisions, then from the point l. bring the third part of the line d. s. vpon the center d. describe an arke of a circle, as is the arke l. o. which is for the transuersary of this staffe, and the line d. s. is for the staffe, then from the point o. where the vpper ende of the transuersary toucheth the line d. n. drawe a parallell to the line d. s. as is the line o. y. and as that line doth cut the lines drawne from the center d. so must the staffe d. s. be graduated, laying it vpon the line o. y. putting that part of the staffe wher the point l. toucheth, vpon the point o. and then from the point l. lay downe the degrees, as are the interfections vpon the line o. y. and so is the staffe graduated.

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other

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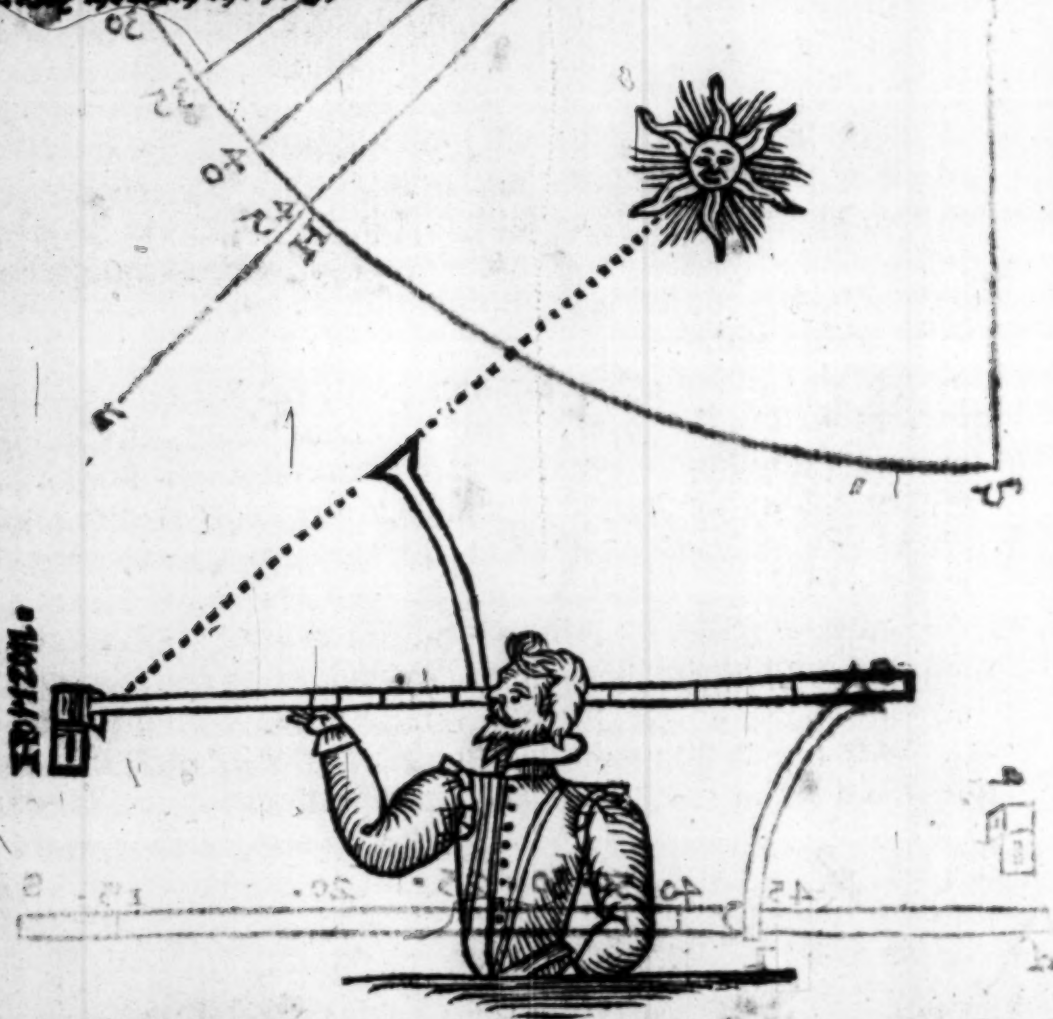
The transversary at the point i. must have an artificial hole made for the staffe to runne in, as other stanes have, also there must bee a plate of brasse with a forcat to be set to the ceter of the staffe, as is the figure a. in the

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whereof there must be a slitte, through which the light must be conveyed to the Horizon, and this plate must receive the shadow of the transversary and so the Staffe is finished.

How is the use of this Staffe?

The use of this Staffe is altogether contrary to the other, for the center of this Staffe where the brasse plate is fastned, must be turned to that part of the Horizon which is from the Sunne, and with your backe toward the Sunne, by the lower edge of the halfe crosse, and through the slitte of the plate you must direct your sight onely to the Horizon, and then moving the transversary as occasion requireth, untill the shadow of your upper edge, of the transversary doe fall directly vpon the said slitte or long hole and also at the same instant you see the Horizon through the slitte, and then the transversary sheweth the height desired.

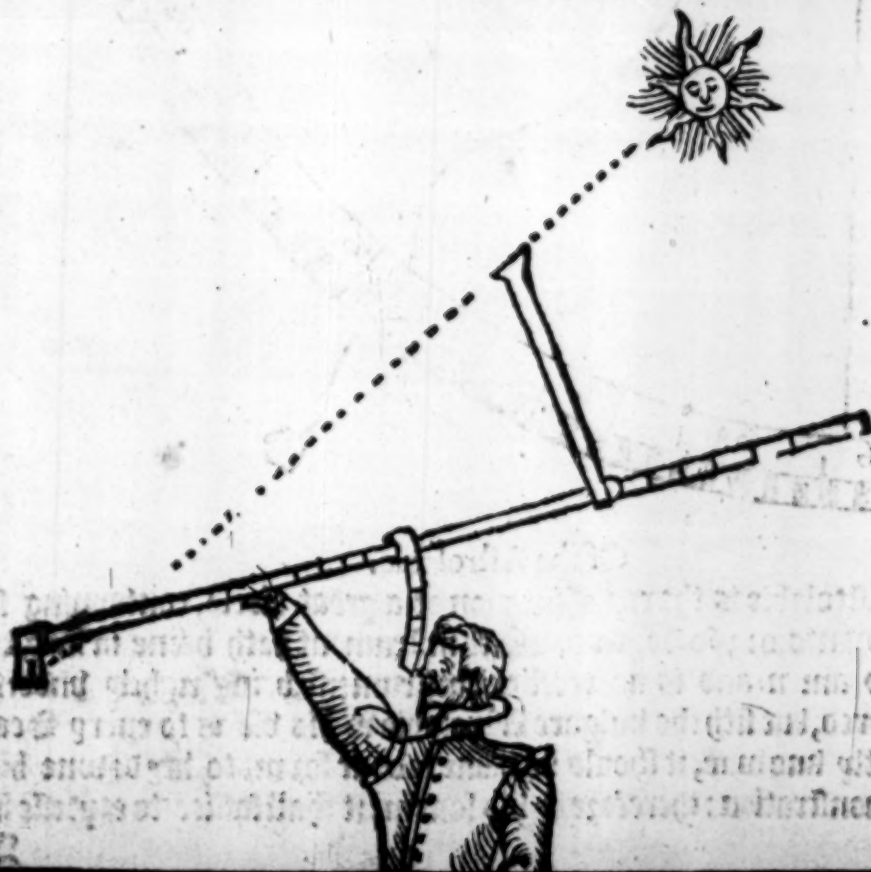


By practice the excellencie of the Crosse Staffe above all other Instruments to latitude the Seamans expectation, and also knowing that

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those instruments whose degrees are of largest capacitie, are instruments of most certaintie. I have very carefully laboured to search a good and demonstrable meane how a Crosse staffe might be presented, not onely to containe large degrees, but also to avoid the uncertaintie of the sight, by disorderly placing of the staffe to the eye, which demonstration I have found, and have had the instrument in practise, as well under the Sun, as in other climates. but because it hath a large demonstration with manifolde uses, I here omit to manifest the same, purposing to write a particular treatise therof, notwithstanding his forme and use, by picture I have thought good to expresse.

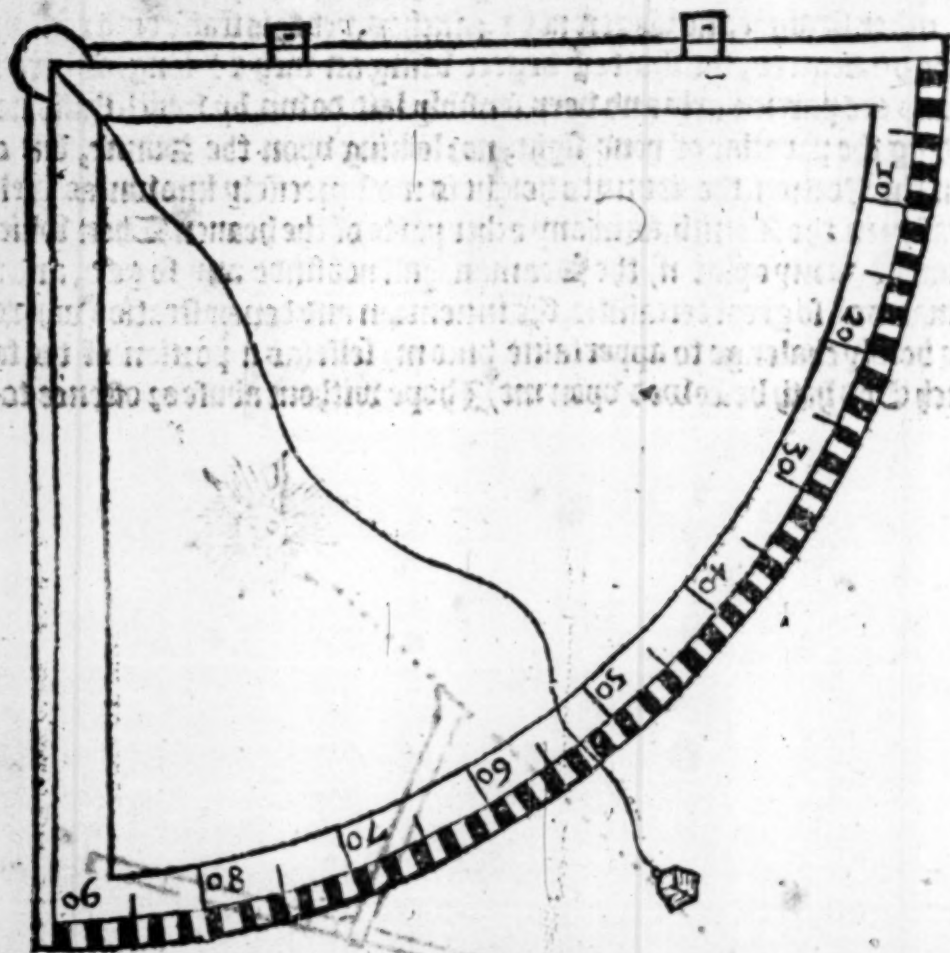
This staffe is a yard long, having 2. halfe crosses, the one circular, the other straight, the longest not 14. inches, yet this staffe both containe the whole 90. degrees, the shortest degree being an inch $\frac{1}{2}$ long, wherein the minutes are particularly and very sensibly laid down, by which staffe not regarding the parallar of your sight, nor looking vpon the Sunne, but onely vpon the Horizon, the Sunnes height is most precisely known, as well and as easily in the Zenith, as in any other parte of the heauen. Then which instrument (in my opiniⁿ) the Seaman shall not finde any so good, and in all Climates of so great certaintie, the inuention and demonstration whereof I may boldly chalenge to appertaine vnto my selfe (as a portion of the talent which God hath bestowed vpon me) I hope without abuse or offence to any.



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Of the Quadrant.

A Quadrant is the fourth part of a circle, containing 90 degrees, and representeth the distance betwene the Horizon and Zenith, being an excellent instrument vpon the shore, to performe any Astronomical observations, but for a Seaman it is to no purpose: and although there may be very much written of the commodious and excellent uses of the Quadrant, yet not being an apt instrument for Sea observations, it shall be from my purpose to write further thereof, and therefore the onely laying downe of his forme may at this present suffice.

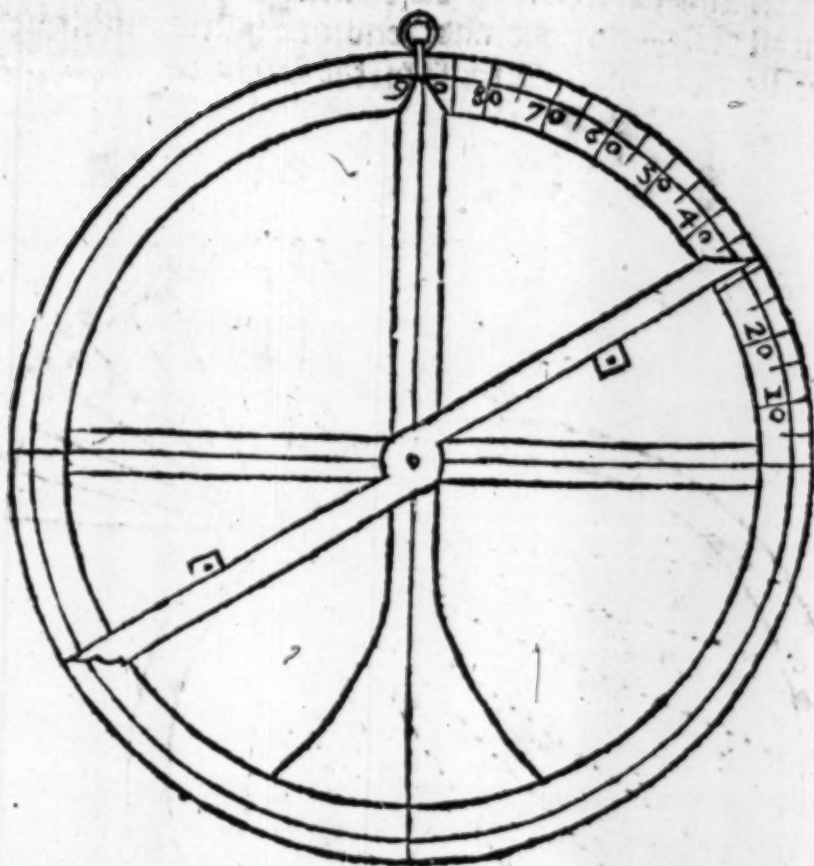


Of the Astrolabe.

A Astrolabe is the representation of a great circle, containing four quadrants, or 360 degrees, which instrument hath bene in long use among Seamen, and is an excellent instrument being rightly understood and ordered, but sith the vulgare Astrolabe to his use is to every Seaman sufficiently knowne, it should be vaine labour for me to lay downe his use and demonstration: therefore by his forme it shall suffice to expresse him.

There

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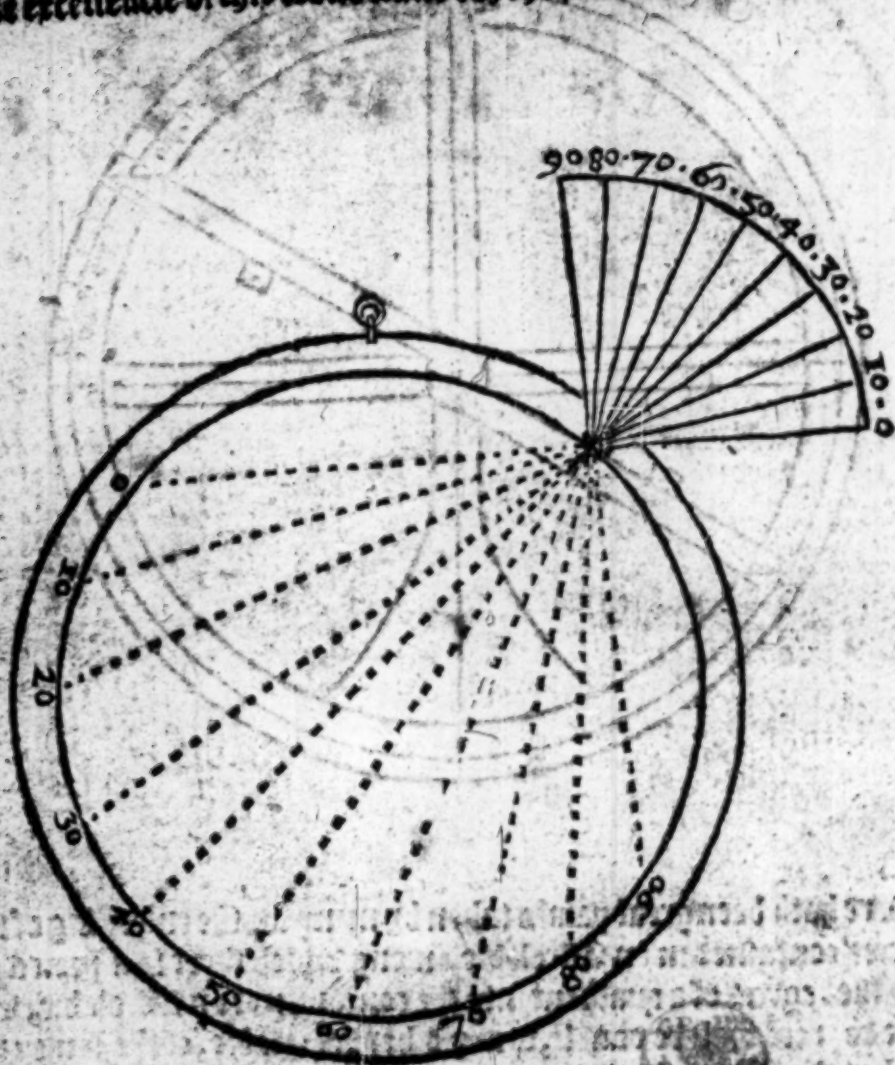
There hath been great paines taken by many for the enlarging of the degrees contained in an Astrolabe, among which there is a projection to convey the degrees of a quadrant into the concavity of an Astrolabe, where by these degrees shall be double, to any other Astrolabe, of the same quantitie, so that the Sunne beame piercing a hole made in the side of the Astrolabe, is thereby caried to the degrees noted, in the opposite concave part, as by his forme may appeare.

Also my selfe labouring in the same matter, have found a meane whereby an Arke of a quadrant whose side is 10. fote, may be converted into an Astrolabe of 10. inches diameter, whose dioptra shall cut his lymbe to right angles, and shall performe the complement of 90. degrees, as amply and as effectually as by the quadrant it may in any sort be done.

Without demonstration, together with the demonstration of my Staffe, I purpose God willing at large to manifest. But there can bee no invention that can establish the certainty of the vse of either Quadrant or Astrolabe at the Sea, for vnlesse it be in very smothe water, there can be no certainty of

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any obseruation by those instruments, to be by the Seaman may rest assured of the fa. which he seeketh, but the obseruations made by the crosse staffe, are without all distrust of errour, and therefore no instrument may compare with the excellencie of this crosse staffe for the Seamans vse.



FINIS.

Printed at London by Thomas Dawson,
dwelling neere the three Cranes in the Vine.

1607.

